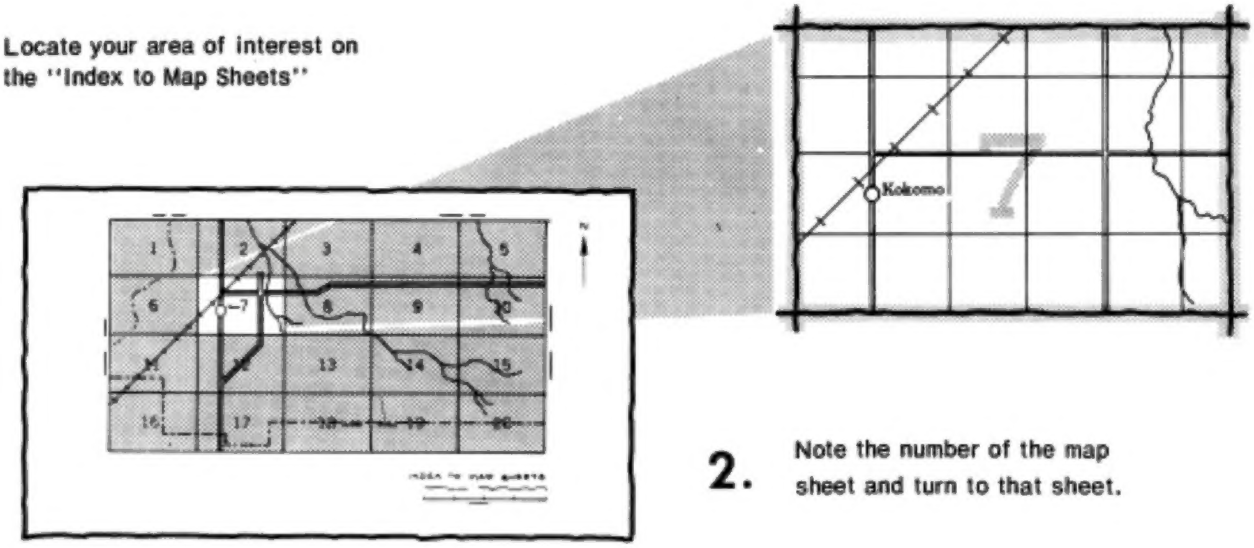
Soil Survey of

Madison County Ohio

United States Department of Agriculture
Soil Conservation Service
in cooperation with
Ohio Department of Natural Resources
Division of Lands and Soils, and
Ohio Agricultural Research and Development Center

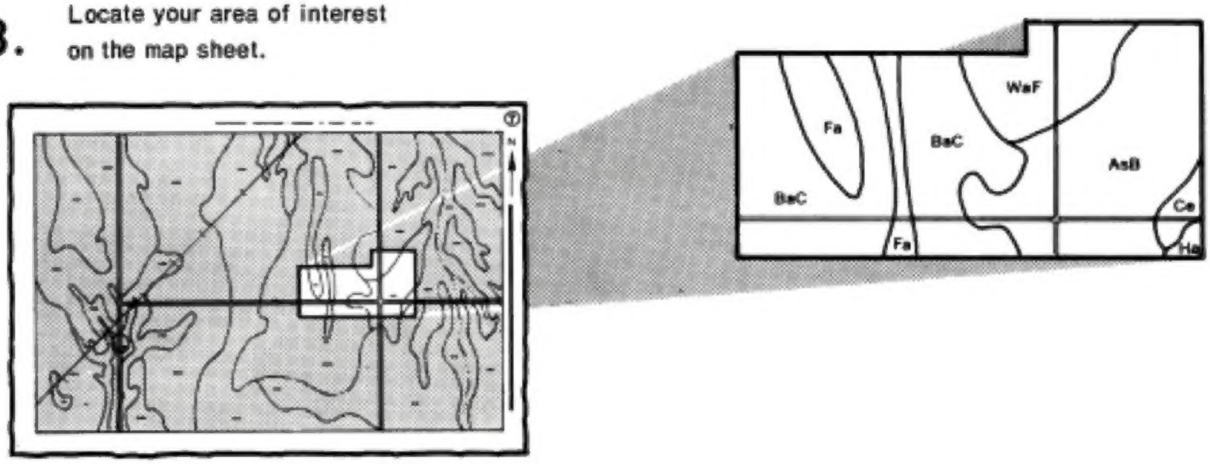
HOW TO USE

1. Locate your area of interest on the "Index to Map Sheets"

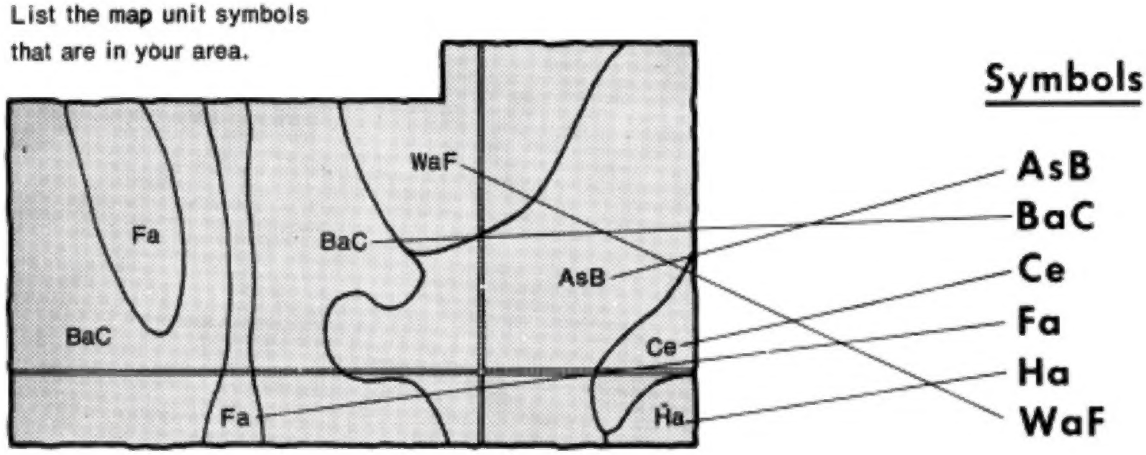


2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.

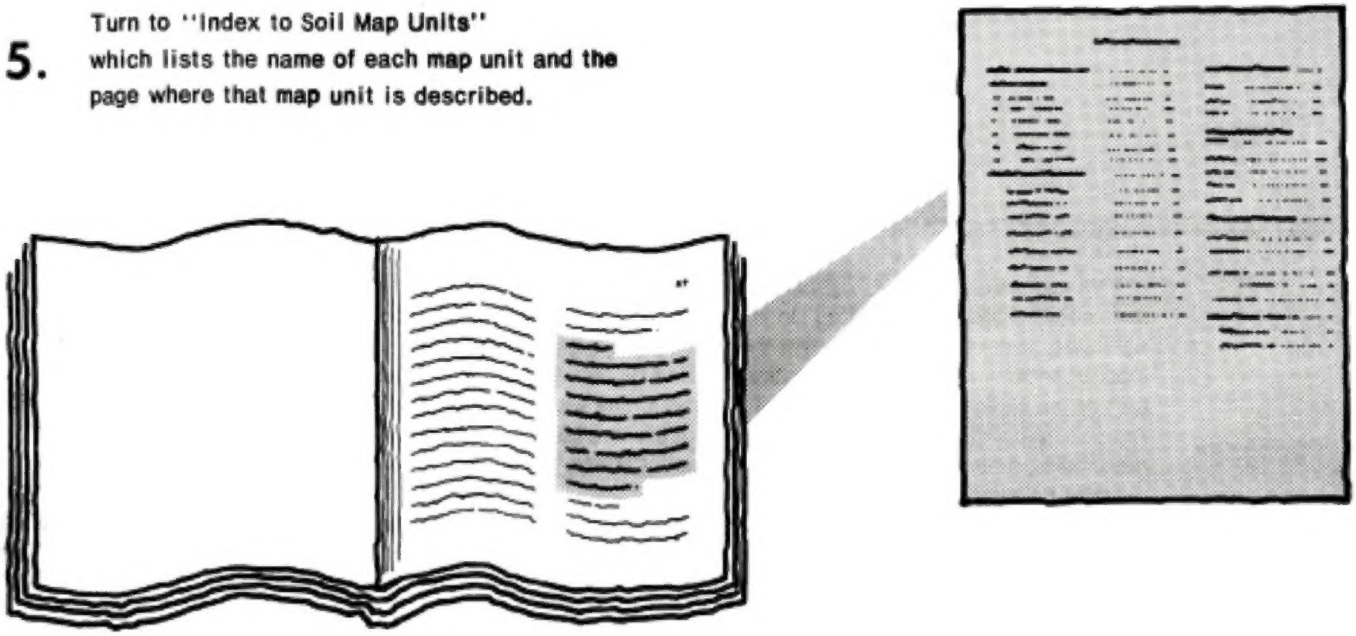


4. List the map unit symbols that are in your area.

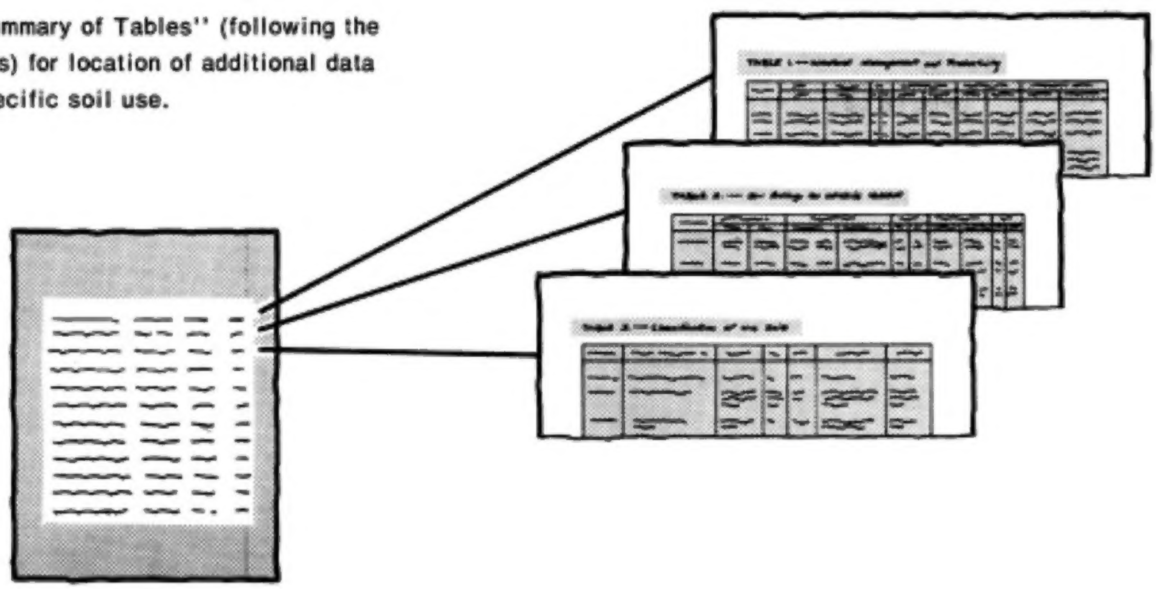


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

This survey was made cooperatively by the Soil Conservation Service and the Ohio Department of Natural Resources, Division of Lands and Soil, and the Ohio Agricultural Research and Development Center. It was materially aided by funds provided by the Madison County Commissioners. The survey is part of the technical assistance furnished to the Madison Soil and Water Conservation District. Major fieldwork was performed in the period 1974-78. Soil names and descriptions were approved in 1978. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1978.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

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soil series

Issued June 1981

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foreword

This soil survey contains information that can be used in land-planning programs in Madison County, Ohio. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations inherent in the soil or hazards that adversely affect the soil, improvements needed to overcome the limitations or reduce the hazards, and the impact of selected land uses on the environment.

This soil survey has been prepared for many different users. Farmers, foresters, and agronomists can use it to determine the potential of the soil and the management practices required for food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use it to plan land use, select sites for construction, develop soil resources, or identify any special practices that may be needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the soil survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur even within short distances. Soils may be seasonally wet or subject to flooding. They may be shallow to bedrock. They may be too unstable to be used as a foundation for buildings or roads. Very clayey or wet soils are poorly suited to septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

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State Conservationist
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soil survey of
Madison County, Ohio

By Jonathan C. Gerken and Ronald J. Scherzinger
Soil Conservation Service

Fieldwork by Jonathan C. Gerken, Ronald J. Scherzinger, Ruby A. Harper and Larry D. Porter

United States Department of Agriculture, Soil Conservation Service
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general nature of the survey area

MADISON COUNTY is in central Ohio just west of the state capital (fig. 1). It is about 463 square miles, or about 296,320 acres. The city of London, near the center of the county, is the county seat. In 1970 the population of the county was 28,318 and the population of London was about 7,500.

Madison County is dominantly agricultural. There are about 1,000 farms, which average 386 acres each. According to the Conservation Needs Inventory (*5*), about 78.9 percent of the land is cropland, 9.6 percent is pasture, 4.5 percent is forest, 3 percent is farmsteads, rural homes, and other areas less than 10 acres, and 4 percent is urban and built-up areas. Cash grain farming is the major enterprise. Corn and soybeans are the main crops. Dairy cattle, beef cattle, and swine are the main livestock.

Urban development, particularly residential development, has increased in recent years. Urbanization will probably continue to increase around West Jefferson in Jefferson Township and around London in Union Township because these areas are near Columbus and Springfield. Most of the land for urbanization will come from cropland.

Factories in London and the surrounding towns produce a variety of products, such as food and food-related items, plastics, and industrial machinery and parts. There are also several farm equipment dealers and grain elevators in the county.

Figure 1.—Location of Madison County in Ohio.

Madison Lake State Park is entirely inside Madison County, and part of the Deer Creek Wildlife Area is in the southeastern part of the county. Both provide a variety of outdoor recreation activities. There is also a residential lake development just north of London.

settlement

The Indian tribes in the area, chiefly the Delaware, Mingo, Shawnee, and Wyandot, used Madison County, especially the Darby Plains area, for hunting. In the early 1800's when settlers began to arrive, the Indians ceased hunting the area. Darby Creeks and Darby Township were named for Chief Darby of the Wyandot tribe.

The first permanent settler in Madison County was Jonathan Alder, who was captured and raised by the Indians. In 1795 after the Treaty of Greenville, Alder chose to live in the Darby Plains area because of its abundant wildlife.

Soon after the treaty more settlers arrived. By 1820, the population of the Madison County area was about 4,800. By 1850, the population was 10,015 and by 1880, it was 20,130.

All of Madison County was in the Virginia Military District. Because people receiving land grants could designate their own boundaries, tracts of land in Madison County are irregular in shape and size.

farming

According to the 1977 Ohio Agricultural Statistics (*9*), 9,127,600 bushels of corn, 3,677,800 bushels of soybeans, and 1,401,300 bushels of wheat were grown on a little more than 214,000 acres. The rest of the acreage is used for other crops, pasture, woodland, and other farm uses. Most crops are sold for processing.

Dairy farms are mainly in the north-central and northeastern parts of the county. Swine are raised mainly in the southern third. Cattle and calves are raised on scattered farms throughout the county. In 1977, hogs and pigs numbered 48,300, cattle and calves more than 29,300, and milk cows and heifers that calved that year 3,400.

Poor natural drainage is the major limitation in the more nearly level areas. Erosion is the major hazard in sloping areas. Most soils in the county are highly productive if wet areas are drained, the hazard of erosion is controlled, and the soil is well managed.

climate

Prepared by the National Climatic Center, Asheville, North Carolina.

Madison County is cold in winter and uncomfortably warm in summer. Winter precipitation, frequently snow, results in an adequate accumulation of soil moisture by spring and minimizes the hazard of summer drought on most soils. Normal annual precipitation is adequate for all crops that are adapted to the temperature and growing season in the area.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Columbus, Ohio, in the period 1951 to 1975. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 31 degrees F, and the average daily minimum temperature is 23 degrees. The lowest temperature during the period of record, which occurred at Columbus on January 28, 1963, is -15 degrees. A temperature of -19 degrees occurred in January of 1977.

In summer the average temperature is 72 degrees, and the average daily maximum temperature is 84 degrees. The highest recorded temperature, which occurred at Columbus on July 14, 1954, is 104 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 36.7 inches. Of this, 22 inches, or 60 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 17 inches. The heaviest 1-day rainfall during the period of record was 4.79 inches at Columbus on January 21, 1959. Thunderstorms occur on about 40 days each year, and most occur in summer.

Average seasonal snowfall is 28 inches. The greatest snow depth at any one time during the period of record was 10 inches; 13 inches, however, was recorded on November 20, 1950. On an average of 12 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 65 percent of the time possible in summer and 35 percent in winter. The prevailing wind is from the south-southwest. Average windspeed is highest, 11 miles per hour, in March.

Tornadoes and severe thunderstorms occur occasionally. These storms are usually of local extent and short duration. They cause damage in a variable pattern.

geology and topography

Madison County is mostly a nearly level and gently undulating ground moraine and a few end moraines (*4*). The dominant texture of the glacial till is loam. The glacial till was laid down by two major advances during the last major glaciation, the Wisconsin glacier. Melt waters from the first advance deposited sand and gravel outwash, which was covered by the second advance. For this reason, many random pockets of sand and gravel are buried under glacial till. Depth to the pockets varies from about 10 feet to more than 150 feet.

Because these buried outwash pockets trap water, they commonly provide an excellent source of water for wells.

The retreat and readvance of the ice formed end moraines. When the ice melted at the same rate that the glacier brought down new debris from the north, the front of the glacier remained stationary and debris accumulated, forming hills. These hills extended along the glacial front, forming a pattern similar to that of a mountain range, but on a much smaller scale.

Parts of five end moraines are in Madison County. The Cable Moraine, a large end moraine that extends into Madison County from the northeast corner of Clark County, forms two branches just northwest of Summerford. The northern branch, the London Moraine, extends through London, curves gently eastward, and crosses the county line about 6 miles south-southeast of Lilly Chapel. The southern branch, the Bloomingburg Moraine, enters the county just west of Summerford and extends discontinuously south-southeast through Midway and just east of State Route 38. The fourth end moraine, the Esboro Moraine, is almost entirely in Stokes Township and is parallel to and just east of State Route 41. A small branch of it between Paint and Sugar Creeks extends northward into Clark County just south of where State Route 42 crosses the Madison-Clark County line. The fifth end moraine, the Reesville Moraine, occupies a very small part of Madison County along the county line adjacent to Greene and Clark Counties.

Gravel and sand outwash were deposited along the major streams by glacial melt water. These deposits are stratified.

End moraines and areas near streams form the only evident relief in the county. Areas of end moraines are mainly gently sloping and sloping. Some are moderately steep. Slopes near streams generally are sloping to steep. The highest point in Madison County, along the west-central county line, is slightly more than 1,200 feet above sea level. The lowest point, in the extreme southeast corner of the county along Deer Creek, is slightly less than 800 feet above sea level.

A large level and nearly level area called the Darby Plains occurs in Canaan, Darby, Monroe, and Pike Townships and in the northern part of Jefferson Township. This area is dominantly very poorly drained, but productive, medium textured and moderately fine textured soils.

In the southwest quarter of the county there are several outwash plains on the south side of end moraines. These plains formed when glacial melt water poured through the moraines carrying debris, and then slowed down depositing the debris when the melt waters reached the open flat areas south of the moraines.

Almost all of Madison County drains into the Scioto River. Less than 1 percent, in the western part of Stokes Township, drains into the Little Miami River. Streamflow is generally from the northwest to the southeast. Deer Creek, the largest drainageway, drains about half the land surface of the county. From its headwaters near Summerford, it flows north, curves east, turns south near Lafayette, and flows southeastward toward Mt. Sterling. It has many small tributaries.

Little Darby Creek, another important creek, flows northward through the northwest corner of Pike Township into Union County where it turns and flows southward back into Madison County and past West Jefferson. Finally, it flows into Big Darby Creek in Franklin County.

The headwaters of Paint Creek in Paint and Stokes Townships and small tributaries of Big Darby Creek south of Plain City drain the rest of the county.

how this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map units" and "Detailed soil map units."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, rangeland and woodland managers, engineers, planners, developers and builders, home buyers, and others.

general soil map units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

soil descriptions

1. Kokomo-Crosby-Lewisburg association

Nearly level and gently sloping, very poorly drained, somewhat poorly drained, and moderately well drained soils formed in glacial till

This association is on the flatter parts of ground moraines. The characteristic landscape is one of broad flats, scattered shallow depressions, and discontinuous knolls and ridges. The lighter colored soils of the knolls and ridges form a contrasting pattern with the darker colored, nearly level Kokomo soils.

This association makes up about 35 percent of the county. It is about 55 percent Kokomo soils, 20 percent Crosby soils, 10 percent Lewisburg soils, and 15 percent soils of minor extent.

Kokomo soils are on broad flats and in some depressional areas. They are very poorly drained. A seasonal high water table is at or near the surface during wet periods. Runoff is very slow or ponded. The root zone is deep or moderately deep.

Crosby soils are on toe slopes and side slopes of knolls and ridges. They are somewhat poorly drained. A seasonal high water table is between depths of 1 and 3 feet during wet periods. Runoff is slow or medium. The root zone is mainly moderately deep over compact glacial till.

Lewisburg soils are on the crests of knolls and ridges. They are moderately well drained. A seasonal high water table is between depths of 2 and 4 feet during wet periods. Runoff is slow or medium. The root zone is mainly shallow over compact glacial till.

Of minor extent in this association are Odell, Patton, and Westland soils. Odell soils are on toe slopes and side slopes of low knolls and on slightly raised benches surrounded by Kokomo soils. Patton soils are in shallow depressions and along small drainageways. Westland soils are along small drainageways.

Most of this association is cultivated. The potential is high for row crops, small grain, hay, and pasture. It is also high for trees and plantings for wildlife. The potential is low for community development and low to medium for most recreation uses.

Wetness is the main limitation in farming. Erosion is a hazard in the gently sloping areas. Surface and subsurface drains are needed. Conservation tillage, which leaves crop residue on the surface, and crop rotations are effective in reducing the hazard of erosion. Wetness in the Kokomo and Crosby soils severely limits homesite development. Wetness in the Kokomo and Crosby soils, slow permeability in the Crosby soils, and moderate to slow permeability in the Lewisburg soils severely limit their use as septic tank absorption fields.

2. Crosby-Kokomo-Lewisburg association

Nearly level and gently sloping, somewhat poorly drained, very poorly drained, and moderately well drained soils formed in glacial till

This association is on undulating parts of ground moraines. The characteristic landscape is one of knolls and ridges that rise slightly above the scattered, darker depressional areas and shallow drainageways that dissect them. These depressions and drainageways form a contrasting pattern with the lighter colored Crosby and Lewisburg soils.

This association makes up about 53 percent of the county. It is about 30 percent Crosby soils, 25 percent Kokomo soils, 20 percent Lewisburg soils, and 25 percent soils of minor extent.

The somewhat poorly drained Crosby soils are on side slopes and toe slopes and on nearly level benches at the top of low knolls. A seasonal high water table is between depths of 1 and 3 feet during wet periods. Runoff is medium or slow. The root zone is mainly moderately deep over compact glacial till.

The very poorly drained Kokomo soils are on broad flats, in shallow depressions, and along shallow

drainageways. A seasonal high water table is at or near the surface during wet periods. Runoff is very slow or ponded. The root zone is deep or moderately deep.

The moderately well drained Lewisburg soils are on the crests of knolls and ridges. A seasonal high water table is between depths of 2 and 4 feet during wet periods. Runoff is medium or slow. The root zone is mainly shallow over compact glacial till.

Of minor extent in this association are Celina, Miamian, Odell, Patton, and Westland soils. Celina soils are on side slopes and crests of knolls and ridges. Miamian soils are in sloping areas along streams that dissect the association. Odell soils are on fans at the head of drainageways and on slightly raised benches adjacent to Kokomo soils. Patton soils are in depressions in the ground moraine and along minor streams. Westland soils are along minor streams and on small, nearly level outwash plains.

This association is used mainly for cultivated crops. The potential is high for row crops, small grain, hay, and pasture and low for community development. It is high for trees and plantings for wildlife and low to medium for most recreation uses.

Erosion is the main hazard in farming these soils. Conservation tillage, which leaves crop residue on the surface, and crop rotations are effective in protecting these soils from erosion. Wetness is also a limitation; surface and subsurface drains are needed. Wetness in the Kokomo and Crosby soils severely limits homesite development. Wetness in Kokomo and Crosby soils and permeability in Crosby and Lewisburg soils severely limit their use as septic tank absorption fields.

3. Lewisburg-Celina-Miamian association

Gently sloping to very steep, moderately well drained and well drained soils formed in glacial till

This association is on the crests and side slopes of upland areas adjacent to major streams and on end moraines that cross the county. Moderately steep to very steep areas are adjacent to alluvial and outwash soils on stream terraces, and gently sloping areas are at the crest of those slopes. Areas on end moraines are commonly gently sloping or sloping.

This association makes up about 7 percent of the county. It is about 30 percent Lewisburg soils, 25 percent Celina soils, 20 percent Miamian soils, and 25 percent soils of minor extent.

Lewisburg soils are on crests of knolls and ridges. They are moderately well drained. A seasonal high water table is between depths of 2 and 4 feet during wet periods. Runoff is medium. The root zone is mainly shallow over compact glacial till.

The gently sloping Celina soils are in areas between knolls and on side slopes. They are moderately well drained. A seasonal high water table is between depths of 2 and 3 1/2 feet during wet periods. Runoff is medium. The root zone is mainly moderately deep over compact glacial till.

The sloping to very steep Miamian soils are adjacent to stream valleys. The gently sloping Miamian soils are at the crests of the sloping to very steep slopes and also on the crests of some knolls and ridges on end moraines. They are well drained. The water table is at a depth of 6 feet or more. Runoff is medium to very rapid. The root zone is mainly moderately deep over glacial till.

Of minor extent in this association are Eldean, Kendallville, Medway, Ross, Sloan, and Westland soils. Eldean soils are on side slopes and in swales of end moraines and at the foot of sloping to very steep areas on stream terraces. Kendallville soils are on side slopes or benches adjacent to stream terraces and on crests or side slopes of some knolls and ridges on end moraines. Medway, Ross, and Sloan soils are on flood plains. Westland soils are in depressions in stream terraces, or they extend along minor streams across the entire valley.

This association is used for cultivated crops, permanent pasture, and trees. The potential for cultivated crops ranges from high in gently sloping areas to poor in very steep areas. The potential is medium or low for community development; some of the best homesites in the county are in the gently sloping areas of this association. The potential is high for trees and plantings for wildlife. It ranges from high to low for recreation, depending on the slope.

Erosion is the main hazard in farming these soils. Conservation tillage, which leaves crop residue on the surface, and crop rotations are effective in reducing erosion in gently sloping and sloping areas. Permanent pasture reduces the risk of erosion in moderately steep and steep areas. The very steep areas are suitable only for woodland. Permeability severely limits the use of these soils as septic tank absorption fields. Wetness is a moderate limitation for homesites on Celina and Lewisburg soils.

4. Sloan-Eldean-Medway association

Nearly level to sloping, very poorly drained, well drained, and moderately well drained soils formed in glacial outwash and alluvium

This association is on stream terraces and flood plains adjacent to the major streams in the county.

This association makes up about 4 percent of the county. It is about 25 percent Sloan soils, 20 percent Eldean soils, 10 percent Medway soils, and 45 percent soils of minor extent.

The very poorly drained Sloan soils are at the base of slope breaks to uplands and stream terraces in flood channels and in depressions on flood plains. A seasonal high water table is at or near the surface during wet periods. Runoff is very slow or ponded. The root zone is deep.

The well drained Eldean soils are on stream terraces between uplands and the flood plain. The water table is at a depth of 6 feet or more. Runoff is slow to rapid. The

root zone is mainly moderately deep over sand and gravel.

The moderately well drained Medway soils are on flood plains and are commonly closest to the stream or on the inside turns of stream meanders. A seasonal high water table is between depths of 12 and 30 inches. Runoff is slow. The root zone is deep.

Of minor extent in this unit are Kendallville, Miamian, Ross, Wea, and Westland soils. Kendallville and Miamian soils are on side slopes of upland areas adjacent to stream terraces. Ross soils are on slightly raised levees adjacent to streams. Wea and Westland soils are in depressions on stream terraces or at the base of upland slopes.

This association is used mainly for cultivated crops and permanent pasture. Most of the commercial gravel operations in the county are in this association. The potential is high for row crops and low for most community development. Some good building sites, however, are on the stream terraces. The potential is high for trees and medium to high for plantings for wildlife and most recreation uses.

Erosion is the main hazard in farming on the sloping soils. Flooding is the main hazard on the flood plains. Conservation tillage, which leaves crop residue on the surface, and crop rotations are effective in reducing erosion. Flooding severely limits most development in the flood plain areas. Wells may be contaminated by unfiltered effluent from sanitary facilities on the outwash terraces.

5. Westland association

Nearly level, very poorly drained soils formed in glacial outwash

This association is on outwash plains and low stream terraces. The characteristic landscape is one of broad flats or long, narrow valleys.

This association makes up about 1 percent of the county. It is about 85 percent Westland soils and 15 percent soils of minor extent.

Westland soils are on broad flats adjacent to glacial end moraines or shallow valleys along minor streams dissecting the upland. They are very poorly drained. A seasonal high water table is at or near the surface during wet periods. Runoff is very slow or ponded. The root zone is deep.

Of minor extent in this association are Crosby, Eldean, and Thackery Variant soils. Crosby soils are on slightly raised knolls surrounded by Westland soils. Eldean and Thackery Variant soils are on knolls or on raised benches adjacent to Westland soils.

This association is used mainly for cultivated crops. The potential is high for row crops, hay, and pasture and low for community development. It is high for trees and wetland wildlife habitat and low for most recreation uses.

Wetness is the main limitation in farming. Surface and subsurface drains are needed. Wetness and ponding severely limit homesite development and sanitary facilities.

detailed soil map units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and management of the soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil, a brief description of the soil profile, and a listing of the principal hazards and limitations to be considered in planning management.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Miamian silt loam, 2 to 6 percent slopes, is one of several phases in the Miamian series.

Some map units are made up of two or more major soils. These map units are called soil complexes.

A *soil complex* consists of two or more soils that occur as areas so intricately mixed or so small that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. The Odell-Lewisburg complex, 0 to 2 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. These dissimiliar soils are described in each map unit. Also, some of the more unusual or strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes some *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, gravel, is an example. Some miscellaneous areas are large enough to be delineated on the soil maps. Some that are too small to be delineated are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

soil descriptions

Ca—Carlisle muck. This nearly level, very poorly drained organic soil is in depressions in the uplands and at the base of upland slopes adjacent to flood plains. It is subject to frequent flooding and ponding as a result of runoff from adjacent soils. Areas are commonly oval and range from 5 to 30 acres. The slope range is 0 to 2 percent.

Typically, the surface layer is black, friable muck about 12 inches thick. The next layer is dark brown and dark reddish brown, friable muck about 42 inches thick. From about 54 to 60 inches is dark gray, friable sedimentary peat and shell fragments. Around the edges of some areas, depth to this sedimentary peat may be less than 54 inches.

About 15 percent of most areas is included areas of organic soils that are 20 to 50 inches of muck over mineral material. Also included are areas of soils that are 12 to 16 inches of silty muck over marl. Several of these areas are north of U.S. Route 40 and east of Byerly Road, and several are south of U.S. Route 40 and east of Glade Run Road in Jefferson and Deer Creek Townships. The marl and the alkaline reaction of the soils in these areas restrict the availability of plant nutrients for crops.

Permeability is moderately rapid to moderately slow in this Carlisle muck, and available water capacity is very high. Runoff is very slow or ponded. A seasonal high water table is near or above the surface. The root zone is deep in drained areas. Organic matter content is very high. Tilth is good.

Most areas support only swamp vegetation and are used as habitat for wetland wildlife. The potential for cultivated crops is medium in drained areas but is low in

undrained areas. The potential is low for pasture and trees and for most recreation uses, building site development, and sanitary facilities. It is high for wetland wildlife habitat.

Most areas are not drained and are poorly suited to row crops. Because of low strength and lack of adequate outlets, installing subsurface drainage is difficult. Because most areas are small, more elaborate drainage practices, such as pump drainage, are not feasible unless this soil can be incorporated into a drainage system with the surrounding area. In drained areas, decomposition of the organic material causes subsidence or shrinkage. Controlling drainage to raise and lower the water table reduces shrinkage. When these soils are dry, soil blowing and fire are severe hazards. Winter cover crops reduce the risk of soil blowing.

Because of low strength, ponding, and wetness, suitability is poor for pasture, woodland, building site development, and sanitary facilities. This soil is a source of commercial peat. Undrained areas provide habitat for ducks, muskrat, and other wetland wildlife.

The capability subclass is Vw. The woodland suitability subclass is 4w.

CrA—Crosby silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on low knolls, in shallow depressions, and on flats at the head of small drainageways in uplands. Individual areas are irregular in shape and commonly range from 5 to 40 acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 6 inches thick. The subsurface layer is brown, friable silt loam about 4 inches thick. The subsoil is brown and yellowish brown, mottled, firm clay loam about 26 inches thick. The substratum to about 60 inches is yellowish brown, mottled, firm loam. In some areas, depth to carbonates is less than 18 inches. In other areas the subsoil contains less clay than is typical. In some areas on end moraines, the gravel content in the substratum is higher than is typical.

Included with this soil in mapping are the very poorly drained Kokomo soils in shallow depressions and along small waterways. Also included are the moderately well drained Lewisburg soils on low knolls and the somewhat poorly drained Odell soils, which occur randomly, mostly between Kokomo and Crosby soils. Included soils make up about 15 percent of most areas.

Permeability is slow in this Crosby soil, and the available water capacity is moderate or high. Runoff is slow. A seasonal high water table is between depths of 12 and 36 inches in winter, spring, and other extended wet periods. The root zone is mainly moderately deep over compact glacial till. Organic matter content is moderate. Tilth is good.

Most areas are used for crops and pasture. The potential is high for crops and pasture and trees. It is medium for most recreation uses and low for most building site development and sanitary facilities.

This soil is suited to row crops and small grain, but it dries slowly in spring. Crops are damaged by excess moisture in the root zone in many years unless subsurface drainage is installed. A complete drainage system is needed with the kind of conservation tillage that leaves part of the crop residue on the surface. After periods of heavy rainfall, the surface of these soils tends to crust when dry. Cropping systems and conservation tillage practices that keep crop residue on the surface protect the surface from the impact of raindrops and reduce crusting. Residue on the surface also slows runoff, increases infiltration, and reduces erosion. Adding manure or other organic residues helps to maintain tilth and increase infiltration.

Although wetness is a limitation, this soil is suited to hay and pasture. Subsurface drainage is needed to maintain yields, particularly where deep-rooted plants are grown. Grazing when the soil is too wet causes severe surface compaction and poor tilth and reduces plant population and vigor.

This soil is suited to trees. Wet-tolerant species should be planted. Harvesting should be limited to the drier periods of the year.

Wetness and slow permeability severely limit building site development and sanitary facilities. Footing drains and basement wall coatings reduce the possibility of wet basements. Building on included areas of Lewisburg soils, if possible, reduces the wetness problem. Building sites should be shaped to drain surface water away from foundations.

The capability subclass is IIw. The woodland suitability subclass is 3o.

CrB—Crosby silt loam, 2 to 6 percent slopes. This gently sloping, somewhat poorly drained soil is on low knolls and on slopes adjacent to waterways in uplands. Slopes are dominantly 2 to 4 percent and 150 to 500 feet long. Individual areas are irregular in shape and commonly range from 5 to 40 acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 8 inches thick. The subsoil is brown and dark yellowish brown, firm, mottled clay loam about 19 inches thick. The substratum to about 60 inches is yellowish brown, mottled, firm loam. In some areas, depth to carbonates is less than 18 inches. In other areas the soils have less clay in the subsoil than is typical.

Included with this soil in mapping are the very poorly drained Kokomo soils in slight depressions and along small waterways. Also included are the moderately well drained Lewisburg soils on scattered knolls. Included soils make up 10 to 20 percent of most areas.

Permeability is slow in this Crosby soil, and the available water capacity is moderate or high. Runoff is medium. A seasonal high water table is between depths of 12 and 36 inches in winter, spring, and other extended wet periods. The root zone is mainly moderately deep over compact glacial till. The organic matter content is moderate. Tilth is good.

Most areas are used for crops and pasture. The potential is high for crops, pasture, and trees. It is medium for most recreation uses and low for building site development and sanitary facilities.

This soil is suited to row crops and small grain. Erosion, however, is a hazard if the surface is left unprotected. After periods of heavy rainfall, the surface of these soils tends to crust when dry. Cropping systems and conservation tillage practices that keep crop residue on the surface protect the surface from the impact of raindrops and reduce crusting. Residue on the surface also slows runoff, increases infiltration, and reduces erosion. Adding manure or other organic residues helps to maintain tilth and increase infiltration. Subsurface drainage is needed to dry the soil earlier in the spring and to increase air and water movement to roots during the growing season. Grassed waterways should be used where water concentrates and flows in natural channels.

Although wetness is a limitation, this soil is suited to hay and pasture. Growing hay in the rotation or for pasture reduces erosion. Subsurface drainage, which lowers the seasonal high water table, is needed, particularly where deep-rooted plants are grown. Grazing when the soil is wet causes severe surface compaction and poor tilth, increases runoff and erosion, and reduces plant population and vigor.

This soil is suited to trees. Wet-tolerant species should be planted. Harvesting should be limited to the drier periods of the year.

Wetness and slow permeability severely limit building site development and sanitary facilities. Footing drains and basement wall coatings reduce the risk of wet basements. Building on included areas of Lewisburg soils, where possible, reduces the problem of wetness. Building sites should be shaped to drain surface water away from foundations.

The capability subclass is IIe. The woodland suitability subclass is 3o.

CsA—Crosby-Lewisburg silt loams, 0 to 2 percent slopes. This unit consists of the nearly level, somewhat poorly drained Crosby soil and moderately well drained Lewisburg soil in uplands. The Crosby soil is dominantly on the lower parts of slopes and between low knolls. The Lewisburg soil is on the knolls. Areas are irregular in shape and commonly range from 5 to 50 acres. A few are several hundred acres.

Areas of this unit are 45 to 65 percent Crosby soil and 25 to 45 percent Lewisburg soil. Areas of the two soils are so intricately mixed or are so small that it is not practical to map them separately.

Typically, the Crosby soil has a dark grayish brown, friable silt loam surface layer about 10 inches thick. The subsoil is brown and dark yellowish brown, mottled, firm clay loam about 21 inches thick. The substratum to about 60 inches is yellowish brown, mottled, firm loam. In some areas, depth to carbonates is less than 18 inches. In other areas on end moraines, gravel content in the substratum is higher than is typical.

Typically, the Lewisburg soil has a brown, friable silt loam surface layer about 8 inches thick. The subsoil is dark yellowish brown and yellowish brown, firm clay loam about 14 inches thick. The substratum to about 60 inches is yellowish brown, mottled, firm loam. Depth to the firm loam substratum is more than 22 inches in some areas.

Included with these soils in mapping are the very poorly drained Kokomo soils along small waterways and in shallow depressions. Also included are the somewhat poorly drained Odell soils, which occur randomly, generally between Kokomo and Crosby soils or on small flats. Included soils make up 10 to 20 percent of most areas.

The Crosby soil is slowly permeable. The available water capacity is moderate to high, and runoff is slow. A seasonal high water table is between depths of 12 and 36 inches in winter, spring, and other extended wet periods. The root zone is mainly moderately deep over compact glacial till. The organic matter content is moderate. Tilth is good.

The Lewisburg soil is moderately or moderately slowly permeable in the subsoil and slowly permeable in the substratum. The available water capacity is moderate, and runoff is slow. A seasonal high water table is between depths of 24 and 48 inches in winter, spring, and other extended wet periods. The root zone is mainly shallow over compact glacial till. The organic matter content is moderate. Tilth is good.

Most areas are used for crops and pasture. In both soils the potential is high for crops, pasture, and trees. It is medium for most recreation uses. The potential is low for most building site development and sanitary facilities in Crosby soils and medium in Lewisburg soils.

These soils are suited to row crops and small grain, but Crosby soils dry and warm slowly in spring so that crops are frequently damaged by excess moisture in the root zone. Subsurface drains are needed. A complete artificial drainage system is needed with the kind of conservation tillage that leaves part of the crop residue on the surface. After periods of intense rainfall, the surface of these soils tends to crust when dry and becomes nearly impervious to water. Crusting increases runoff and erosion and slows movement of air and water to plant roots. Conservation tillage protects the surface from the impact of raindrops and reduces crusting. Residue on the surface also slows runoff, increases infiltration, and reduces erosion. Adding manure or other organic residues helps to maintain tilth and increase infiltration.

Although wetness is a limitation, these soils are suited to hay and pasture. Subsurface drainage is needed to lower the seasonal high water table in the Crosby soil, especially if deep-rooted plants are grown. Grazing when the soil is wet compacts the surface, causes poor tilth, and reduces plant population and vigor.

These soils are suited to trees. Shallowness over the calcareous substratum in the Lewisburg soil may cause

nutrient deficiencies in some plants. Wet-tolerant species should be planted on the Crosby soil. Harvesting should be limited to the drier periods of the year.

The Lewisburg soil is better suited to building site development and sanitary facilities than the Crosby soil. In both soils, however, wetness and slow permeability are limitations. Footing drains and basement wall coatings reduce the risk of wet basements. Building sites should be shaped to drain surface water away from foundations.

The capability subclass is IIw. The woodland suitability subclass is 3o for the Crosby soil and 2o for the Lewisburg soil.

CsB—Crosby-Lewisburg silt loams, 2 to 6 percent slopes. This unit consists of the gently sloping, somewhat poorly drained Crosby soil and moderately well drained Lewisburg soil in uplands. The Crosby soil is mainly on the lower parts of slopes and between low knolls. The Lewisburg soil is on the knolls. Slopes commonly are 50 to 1,500 feet long. Most areas are irregular in shape and range from 10 to 500 acres.

Areas are 45 to 65 percent Crosby soil and 25 to 45 percent Lewisburg soil. Areas of the two soils are so intricately mixed or are so small that mapping them separately is not practical.

Typically, the Crosby soil has a dark grayish brown, friable silt loam surface layer about 9 inches thick. The subsoil is brown and dark yellowish brown, mottled, firm clay loam about 21 inches thick. The substratum to about 60 inches is yellowish brown, mottled, firm loam. In some areas, the depth to carbonates is less than 18 inches. In some areas on end moraines the gravel content in the substratum is higher than is typical.

Typically, the Lewisburg soil has a brown, friable silt loam surface layer about 9 inches thick. The subsoil is dark yellowish brown and yellowish brown, firm clay loam about 12 inches thick. The substratum to about 60 inches is yellowish brown, mottled, firm loam. Depth to the substratum is more than 22 inches in some areas.

Included with these soils in mapping are the very poorly drained Kokomo soils along waterways and in shallow depressions. Also included are the somewhat poorly drained Odell soils on toe slopes and narrow flats. On some knolls the soils are eroded, have a clay loam surface layer, and have limestone fragments and carbonates within a depth of 10 inches. In these areas tilth is poorer than it is in uneroded areas. Included soils make up about 10 to 15 percent of most areas.

Permeability is slow in this Crosby soil, and the available water capacity is moderate to high. Runoff is medium. A seasonal high water table is between depths of 12 and 36 inches in spring, winter, and other extended wet periods. The root zone is mainly moderately deep over compact glacial till. The organic matter content is moderate. Tilth is good.

Permeability is moderate or moderately slow in the subsoil and slow in the substratum of this Lewisburg soil. The available water capacity is moderate. Runoff is medium. A seasonal high water table is between depths of 24 and 48 inches in spring, winter, and other extended wet periods. The root zone is mainly shallow over compact glacial till. The organic matter content is moderate. Tilth is good.

Most areas are used for crops and pasture. A few are used for residential purposes. In both soils the potential is high for crops, pasture, and trees and is medium for most recreation uses. The potential for most building site development and sanitary facilities is low in the Crosby soil and medium in the Lewisburg soil.

Crosby and Lewisburg soils are suited to crops commonly grown in the county, such as corn, soybeans, and wheat. Erosion is a hazard if the surface is left unprotected. After periods of heavy rainfall, the surface of these soils tends to crust when dry. Crusting increases runoff and erosion and decreases the rate at which air and water move to plant roots. Erosion on the Lewisburg soil is especially damaging because it reduces the available water capacity and because further tillage mixes subsoil material, which has a high clay content, with the surface layer and damages tilth. Seed germination is reduced in eroded areas during dry seasons and in areas where no-till planting is used. Cropping systems and conservation tillage practices that leave crop residue on the surface protect the surface from the impact of raindrops and reduce crusting. The residue slows surface runoff, increases the rate of water infiltration, and reduces erosion. Adding manure or other organic residue helps to maintain tilth. Grassed waterways should be used where water concentrates and flows in natural channels. Crosby soils dry and warm slowly in spring. Excess water frequently damages crops during the growing season. Artificial drainage is needed.

Although wetness is a limitation, these soils are suited to hay and pasture. Growing hay for pasture or in the rotation reduces erosion. Subsurface drainage is needed to lower the seasonal high water table in the Crosby soil, particularly where deep-rooted plants are grown. Grazing when the soil is wet causes severe surface compaction and poor tilth, increases runoff and erosion, and reduces plant population and vigor.

These soils are suited to trees. In the Lewisburg soil shallowness over calcareous glacial till may cause nutrient deficiencies in some plants. Wet-tolerant species should be planted in the Crosby soil. Harvesting should be limited to the drier parts of the year.

The Lewisburg soil is better suited than the Crosby soil to building site development and sanitary facilities. Wetness and slow permeability are limitations in both soils. Footing drains and basement wall coatings help to prevent wet basements. Wetness and slow permeability severely limit the use of both soils as septic tank absorption fields. Erosion is a hazard during construction. It can be especially damaging in Lewisburg soils, which have a shallow zone favorable to root development. A temporary plant cover should be

established as soon as possible to reduce erosion during construction. Building sites should be shaped to drain surface water away from foundations.

The capability subclass is IIe. The woodland suitability subclass is 3o for the Crosby soil and 2o for the Lewisburg soil.

EIA—Eldean silt loam, 0 to 2 percent slopes. This nearly level, well drained soil is on stream terraces and on outwash plains in uplands. Individual areas are oblong or irregular in shape and commonly range from 5 to 40 acres. A few areas are up to 100 acres.

Typically, the surface layer is brown, friable silt loam about 9 inches thick. The subsoil is about 26 inches thick. It is brown and reddish brown, firm clay loam and clay in the upper part and brown, loose gravelly loam in the lower part. The substratum to about 60 inches is brown, loose gravelly loamy sand. In some areas, depth to the substratum is greater than 40 inches.

Included with this soil in mapping are the moderately well drained Thackery Variant soils on flats, in shallow depressions, and in waterways. Small knolls of the well drained Kendallville soils surrounded by Eldean soils are in some areas. Included soils make up 5 to 15 percent of most areas.

Permeability is moderate or moderately slow in the subsoil and rapid or very rapid in the substratum of this Eldean soil. The available water capacity is low or moderate. Runoff is slow. The root zone is mainly moderately deep over loose sand and gravel. The organic matter content is moderate. Tilth is good.

Most areas are used for crops and pasture. The potential is high for crops, pasture, trees, most recreation uses, and most building site development.

Crops commonly grown in the county, such as corn, soybeans, and wheat are well suited to Eldean soils, as are many fruits and vegetables not commonly grown. Because the root zone is moderately deep and the available water capacity low or moderate, the soil is often droughty. The silt loam surface layer tends to crust as it dries after heavy rains. Crusting seals the surface and reduces infiltration. Conservation tillage reduces the impact of heavy rains and reduces crusting. Adding manure and other organic residues helps to maintain tilth and reduce crusting.

This soil is suited to hay and pasture. It can be grazed early in spring. In dry years, summer growth is low because of droughtiness. Pastures should not be overgrazed. Overgrazing compacts the surface, causes poor tilth, and reduces plant population and vigor.

Trees grow well. Species planted, however, should be adapted to dry sites.

This soil is suited to building site development. The possibility of ground water contamination limits its use for sanitary facilities. The soil is a good source of sand and gravel. Particle size varies greatly. In some areas, there is a high content of sand in the substratum and very little gravel. In other areas the gravel content ranges up to 70 or 75 percent.

The capability subclass is IIs. The woodland suitability subclass is 2o.

EIB—Eldean silt loam, 2 to 6 percent slopes. This gently sloping, well drained soil is on stream terraces and on outwash plains in uplands. Slopes commonly are 20 to 500 feet long. Areas are oblong or irregular in shape. Most range from 5 to 50 acres. A few are up to several hundred acres.

Typically, the surface layer is brown, friable silt loam about 10 inches thick. The subsoil is about 26 inches thick. It is brown and reddish brown, firm loam, clay loam, and clay in the upper part and brown, friable gravelly loam in the lower part. The substratum to about 60 inches is brown very gravelly coarse sandy loam. In some areas, depth to loose sand and gravel is less than 20 inches, and in others it is more than 40 inches. There are some moderately eroded areas, mostly on the steeper parts of the map units.

Included with this soil in mapping are the moderately well drained Thackery Variant soils in shallow depressions and waterways. Also included are the well drained Kendallville soils, which are underlain by glacial till, on higher slopes or on knolls surrounded by Eldean soils. Included soils make up 10 to 15 percent of most areas.

Permeability is moderate or moderately slow in the subsoil and rapid or very rapid in the substratum of this Eldean soil. Available water capacity is low or moderate, and runoff is medium. The root zone is mainly moderately deep over loose sand and gravel. Organic matter content is moderate. Tilth is good.

Most areas of this soil are used for crops and pasture. The potential is high for crops, pasture, trees, most recreation uses, and most building site development.

Crops commonly grown in the county, such as corn, soybeans, and wheat, are well suited to Eldean soils, as are many fruits and vegetables not commonly grown. Erosion, which is a hazard, is particularly damaging because it reduces the available water capacity and increases droughtiness. The silt loam surface layer tends to crust as it dries after heavy rains. Crusting seals the surface, reduces the infiltration rate, and increases runoff and erosion. Conservation tillage and cropping systems that leave crop residue on the surface reduce the impact of raindrops and reduce crusting. The residue also slows surface runoff and increases infiltration. Adding manure and other organic residues helps to maintain tilth and the available water capacity and reduces crusting. Grassed waterways should be used where water concentrates and flows in natural channels.

Pasture and hay are effective in protecting this soil from erosion. Pastures can be grazed early in spring. During dry years, summer growth is poor because of droughtiness. Pastures should not be overgrazed. Overgrazing compacts the surface, causes poor tilth, increases runoff and erosion, and reduces plant population and vigor.

Trees grow well. Species planted, however, should be adapted to dry sites. Logging roads and skid trails should be protected from erosion.

This soil is suited to building site development. It erodes easily unless adequate cover is maintained during construction. The possibility of ground water contamination limits its use for sanitary facilities. The soil is a good source of sand and gravel. Particle size varies greatly. In some areas the soil has a high content of sand in the substratum and very little gravel. In other areas, the gravel content ranges to 70 or 75 percent.

The capability subclass is IIe. The woodland suitability subclass is 2o.

EIC2—Eldean silt loam, 6 to 12 percent slopes, eroded. This sloping, well drained soil is on stream terraces. Slopes are commonly 100 to 300 feet long. Individual areas are long and narrow and commonly range from 5 to 20 acres.

Typically, the surface layer is brown, friable silt loam about 8 inches thick. The subsoil is about 21 inches thick. It is brown, firm clay loam in the upper part and brown, friable gravelly clay loam in the lower part. The substratum to about 60 inches is brown, loose gravelly sand. In some areas, depth to loose sand and gravel is less than 20 inches. Some areas are severely eroded. In some areas, slopes are 12 to 25 percent.

Included with this soil in mapping are the well drained Kendallville soils, which are underlain by glacial till. They occur at random locations in the map unit but make up 5 to 15 percent of most areas.

Permeability is moderate or moderately slow in the subsoil and rapid or very rapid in the substratum of this Eldean soil. The available water capacity is low. Runoff is rapid. The root zone is mainly moderately deep over loose sand and gravel. The organic matter content is moderately low. Tilth is good.

Most areas of this soil are used for crops and pasture. The potential is medium for crops. It is high for pasture and trees. It is medium for most recreation uses and building site development.

Although erosion is a hazard, this soil is suited to crops commonly grown in the county, such as corn, soybeans, and wheat, as well as to many fruits and vegetables not commonly grown. It is droughty during extended dry periods. Because of the low available water capacity, it is better suited to early crops than to crops that mature late in summer. The silt loam surface layer tends to crust as it dries after heavy rains, reducing infiltration and increasing runoff and the risk of erosion. Cropping systems and conservation tillage practices that keep maximum cover on the surface reduce erosion and help to maintain tilth and increase infiltration. Because the surface layer is eroded, no-till planting may result in poor germination. Adding manure and other organic residue helps to maintain tilth and increase the available water capacity. Grassed waterways should be used where water concentrates and flows in natural channels.

Pasture and hay help to protect this soil from erosion. Because of the erosion hazard and the low available water capacity, pasture should not be overgrazed. Overgrazing compacts the surface, causes poor tilth, increases runoff and erosion, and reduces plant population and vigor. Drought-tolerant species should be seeded.

Woodland productivity is high. Plant competition can be reduced by cutting, spraying, girdling, or mowing. Species selected for planting should tolerate dry conditions. Logging roads and skid trails should be protected against erosion. Nutrient deficiencies occur in some plants in included areas of soils that are shallow over loose sand and gravel.

Although slope is a moderate limitation, this soil is suited to building site development. The soil erodes easily unless adequate cover is maintained during construction. It is droughty for lawns during dry periods. The possibility of ground water contamination limits its use for sanitary facilities.

The capability subclass is IIIe. The woodland suitability subclass is 2o.

KeB—Kendallville silt loam, 2 to 6 percent slopes. This gently sloping, well drained soil is in uplands adjacent to stream terraces and outwash plains and on end moraines. Slopes are commonly 200 to 1,000 feet long. Individual areas commonly range from 5 to 50 acres. A few range up to several hundred acres.

Typically, the surface layer is brown, friable silt loam about 8 inches thick. The subsoil is brown and yellowish brown, friable and firm clay loam about 28 inches thick. The substratum to about 60 inches is yellowish brown, firm loam. In some areas the subsoil contains more clay than is typical.

Included with this soil in mapping are small areas of the well drained Eldean and Miamian soils. Those soils are most common on end moraines and on uplands adjacent to outwash plains. Typically, the Eldean soil is in concave areas between knolls or ridges, and the Miamian soil is on the crest of knolls and ridges. Included soils make up 5 to 15 percent of most areas.

Permeability is moderately slow in this Kendallville soil, and the available water capacity is moderate. Runoff is medium. The root zone is mainly moderately deep over compact glacial till. The organic matter content is moderate. Tilth is good.

Most areas of this soil are farmed. The potential is high for crops, pasture, trees, most recreation uses, and most building site development. It is medium for sanitary facilities.

This soil is suited to row crops and small grain. Erosion, however, is a hazard unless the surface is protected. After periods of intense rainfall, the surface tends to crust when dry and is then nearly impervious to water. Crusting reduces the rate of infiltration and increases runoff and erosion. Cropping systems and conservation tillage practices that keep crop residue on

the surface protect the surface from the impact of raindrops and reduce crusting. Residue left on the surface also slows surface runoff, increases infiltration, and reduces erosion. Adding manure and other organic residue reduces crusting and helps to maintain tilth and the available water capacity. Grassed waterways should be used where water concentrates and flows in natural channels.

Pasture and hay are effective in protecting this soil from erosion. Overgrazing or grazing when the soil is wet compacts the surface, causes poor tilth, increases runoff and erosion, and decreases plant population and vigor.

Trees grow well if competing vegetation is controlled or removed by cutting, spraying, girdling, or mowing. Logging roads and skid trails should be protected from erosion.

Although the shrink-swell potential is a moderate limitation, this soil is well suited to most building site development. Runoff and erosion increase during construction. As much cover as possible should be maintained to reduce soil loss. The moderately slow permeability severely limits the use of the soil as septic tank absorption fields.

The capability subclass is IIe. The woodland suitability subclass is 1o.

KeC2—Kendallville silt loam, 6 to 12 percent slopes, eroded. This sloping, well drained soil is on smooth slopes adjacent to stream terraces in uplands and on rolling topography on end moraines. Slopes commonly are 200 to 400 feet long. Individual areas commonly range from 5 to 40 acres.

Typically, the surface layer is brown, friable silt loam about 8 inches thick. The subsoil is about 19 inches thick. It is brown, firm silt loam in the upper part and brown and dark yellowish brown, firm clay loam in the lower part. The substratum to about 60 inches is dark yellowish brown, firm loam. In some areas there is more clay in the subsoil than is typical.

Included with this soil in mapping are small areas of the well drained Eldean soils, typically on end moraines in concave areas between knolls and ridges. Also included are areas of severely eroded soils. Included soils make up as much as 20 percent of some areas.

Permeability is moderately slow in this Kendallville soil, and the available water capacity is moderate. Runoff is rapid. The root zone is mainly moderately deep over compact glacial till. Organic matter content is moderately low. Tilth is good.

Most areas are used for crops or pasture. The potential is medium for crops and high for pasture and trees. It is medium for most recreation uses, most building site development, and sanitary facilities.

This soil is suited to crops normally grown in the county, such as corn, soybeans, and wheat. Erosion, however, is a hazard. The surface tends to crust as it dries after heavy rains. Crusting decreases the rate of infiltration and increases surface runoff and erosion. Cropping systems and conservation tillage practices that keep crop residue on the surface protect the surface from the impact of raindrops and reduce crusting. The residue also slows surface runoff, increasing infiltration and reducing runoff and erosion. Adding manure and other organic residue reduces crusting and helps to maintain tilth and available water capacity. Because the surface is eroded, no-till planting may result in poor germination. Grassed waterways should be used where water concentrates and flows in natural channels.

Pasture and hay protect the soil from erosion. Because of the erosion hazard and the moderate available water capacity, pastures should not be overgrazed. Overgrazing or grazing when the soil is wet compacts the surface, causes poor tilth, increases runoff and erosion, and decreases plant population and vigor.

Productivity of woodland is high. Plant competition can be reduced by cutting, spraying, girdling, or mowing. Logging roads and skid trails should be protected against erosion. Species planted should be adapted to well drained sites.

Although the shrink-swell potential and slope are limitations, this soil is suited to most building site development. It erodes easily unless adequate cover is maintained during construction. Moderately slow permeability severely limits its use as septic tank absorption fields.

The capability subclass is IIIe. The woodland suitability subclass is 1o.

Ko—Kokomo silty clay loam. This nearly level, very poorly drained soil is on the lowest positions in uplands. It is commonly in slightly concave depressions and along small intermittent waterways or in broad areas between low knolls. It is subject to ponding as a result of runoff from adjacent soils. The slope range is 0 to 2 percent. Areas commonly range from 20 to several hundred acres. A few range to several thousand acres.

Typically, the surface layer is very dark gray, friable silty clay loam about 10 inches thick. The subsoil is mottled, firm clay loam about 22 inches thick. The upper part is very dark grayish brown, and the lower part is dark grayish brown and grayish brown. The substratum to about 60 inches is grayish brown and gray, mottled, calcareous, firm loam. In some places the soil is better drained and has a calcareous, firm loam substratum at a depth of less than 30 inches.

Included with this soil in mapping are slightly depressional areas where the surface layer and subsoil are calcareous. In these areas nutrient deficiencies may occur in some plants, and special fertilizers may be required. Also included are some areas of the somewhat poorly drained Crosby soils on slightly raised knolls. Those areas, less than 2 acres, make up less than 10 percent of most areas. Small areas of the very poorly drained Westland soils and poorly drained Patton soils are along small streams and in depressions. They make up less than 5 percent of most areas.

Permeability is moderately slow in this Kokomo soil, and the available water capacity is high. Runoff is very slow or ponded. A seasonal high water table is at or near the surface in winter, spring, and other extended wet periods. The root zone is deep or moderately deep. The organic matter content is high. Tilth is good.

Most areas are used as cropland. The potential is high for crops, pasture, and trees. It is low for most recreation uses, building site development, and sanitary facilities.

Although wetness is a limitation, this soil is suited to row crops and small grain. Wetness reduces yields. The soil dries slowly in spring unless it is artificially drained. Surface drains and grassed waterways are needed. Subsurface drains are also needed (fig. 2). A complete artificial drainage system is needed with the kind of conservation tillage that leaves part of the crop residue on the surface. Conservation tillage, such as chisel, disk, or rotary tillage, which incorporates part of the crop residue and leaves part on the soil surface, increases the rate of water infiltration. Crop residue on the soil surface holds snow cover and reduces erosion and soil blowing. No-till planting may be an alternative if tillage is delayed because of wetness.

This soil is suited to pasture or hay. Wet-tolerant plants should be seeded. Surface drains are needed in some areas. Subsurface drainage is needed to lower the high water table, especially where deep-rooted plants are grown. Grazing when the soil is wet causes severe

Figure 2.—Surface and subsurface drainage in an area of nearly level Kokomo silty clay loam.

surface compaction and poor tilth and reduces plant population and vigor.

Wetness is the main limitation in growing or harvesting trees. The soil is suited to wet-tolerant species. Harvesting and controlling competing vegetation are limited to the drier periods of the year.

Wetness and ponding severely limit building site development. Surface drains and storm sewers are needed. Footing drains and basement wall coatings reduce the risk of wet basements. The included drier Crosby soils are better suited as building sites. Building sites should be shaped to drain surface water away from foundations.

The capability subclass is IIw. The woodland suitability subclass is 2w.

LeB—Lewisburg-Celina silt loams, 2 to 6 percent slopes. This map unit consists of gently sloping, moderately well drained soils on end moraines and ground moraines. Slopes are commonly 4 to 6 percent and 200 to 2,000 feet long. Areas are adjacent to drainageways or on knolls surrounded by wetter soils. Most range from 5 to 80 acres. A few range to several hundred acres.

Areas of this unit are 40 to 60 percent Lewisburg silt loam and 25 to 35 percent Celina silt loam. The Lewisburg soil is commonly on crests of knolls, and the Celina soil is in less sloping areas between knolls and on side slopes. Individual areas of the two soils are so intricately mixed or so small in size that it is not practical to map them separately.

Typically, the Lewisburg soil has a dark grayish brown, friable silt loam surface layer about 8 inches thick. The subsoil is about 14 inches thick. It is dark yellowish brown, firm clay loam in the upper part and yellowish brown, firm clay in the lower part. The substratum to about 60 inches is yellowish brown, mottled, firm loam. In some eroded areas, the surface layer is clay loam and limestone fragments are at the surface.

Typically, the Celina soil has a brown, friable silt loam surface layer about 9 inches thick. The subsoil is firm clay loam about 17 inches thick. It is dark yellowish brown in the upper part and yellowish brown and mottled in the lower part. The substratum to about 60 inches is yellowish brown and brown, mottled, firm clay loam and loam. In some areas, there is less clay in the subsoil. In others, depth to a calcareous, firm clay loam and loam substratum is greater than 40 inches.

Included with these soils in mapping are small areas of the somewhat poorly drained Crosby soils along drainageways, in depressions, and on toe slopes adjacent to wetter soils. Also included are the well drained Miamian soils on the side slopes of knolls. Included soils make up 15 to 20 percent of most areas.

The Lewisburg soil is moderately or moderately slowly permeable in the subsoil and slowly permeable in the substratum. The available water capacity is moderate, and runoff is medium. A seasonal high water table is between depths of 24 and 48 inches in winter, spring, and other extended wet periods. The root zone is mainly shallow over compact glacial till. The organic matter content is moderate. Tilth is good.

The Celina soil is moderately slowly permeable. The available water capacity is moderate or high, and runoff is medium. A seasonal high water table is between depths of 24 and 42 inches in winter, spring, and other extended wet periods. The root zone is mainly moderately deep over compact glacial till. The organic matter content is moderate. Tilth is good.

Most areas are in crops and pasture. The potential is high for crops, pasture, and trees. It is moderate for most recreation uses, most building site development, and sanitary facilities.

These soils are well suited to row crops and small grain. Erosion, however, is a hazard unless the surface is protected. The surface tends to crust as it dries after heavy rains. Crusting decreases the rate of infiltration and increases runoff and erosion. Cropping system and conservation tillage practices that keep crop residue on the surface protect the surface from the impact of raindrops and reduce crusting. The residue also slows surface runoff, increases infiltration, and reduces runoff and erosion. Adding manure and other organic residues also reduces crusting and helps to maintain tilth and available water capacity. Grassed waterways should be used where water concentrates and flows in natural channels.

Pasture and hay are effective as protection against erosion. Overgrazing or grazing when the soil is wet compacts the surface, causes poor tilth, increases runoff and erosion, and decreases plant population and vigor.

Trees grow well if competing vegetation is controlled or removed by cutting, spraying, girdling, or mowing. Logging roads and skid trails should be protected from erosion. Shallowness over calcareous glacial till may cause nutrient deficiences in some plants in the Lewisburg soil.

Wetness moderately limits both soils for most building site development. Footing drains and basement wall coatings reduce the possibility of wet basements. Runoff and erosion increase during construction. As much cover as possible should be maintained to reduce soil loss. Building sites should be shaped to drain surface water away from foundations. Permeability is a severe limitation for septic tank absorption fields.

The capability subclass is IIe. The woodland suitability subclass is 2o for the Lewisburg soil and 1o for the Celina soil.

Mk—Medway silt loam, occasionally flooded. This nearly level, moderately well drained soil is on flood plains along major streams. It is subject to occasional flooding. Areas are long and narrow. Most range from 20 to 50 acres. A few range to 200 acres. The slope range is 0 to 2 percent.

Typically, the surface soil is very dark grayish brown and very dark gray, friable silt loam about 15 inches

thick. The subsoil is about 19 inches thick. The upper part is dark grayish brown, mottled, friable silt loam, and the lower part is brown, mottled, firm clay loam and loam. The substratum to about 60 inches is grayish brown, mottled, firm gravelly loam. In a few small areas along streams and on natural levees the thickness of the surface soil is more than 24 inches.

Included with this soil in mapping are the very poorly drained Sloan soils in depressions, in high water channels, and at the base of slope breaks to uplands. Sloan soils make up 5 to 10 percent of most areas.

Permeability is moderate in this Medway soil, and the available water capacity is high. Runoff is slow. A seasonal high water table is at a depth of 12 to 30 inches in winter, spring, and other extended wet periods. The root zone is deep. The organic matter content is high. Tilth is good.

Most areas are in crops or pasture (fig. 3). The potential is high for crops, pasture, and trees. It is medium for most recreation uses and low for building site development and sanitary facilities.

Row crops are well suited to this soil. Winter wheat, however, may be damaged by flooding in winter and spring. Weed control may be a problem in areas of no-till planting.

This soil is well suited to pasture. Pasture should not be grazed when wet. Grazing when the soil is wet compacts the surface, causes poor tilth, and reduces plant population and vigor.

Trees grow well if competing vegetation is controlled by cutting, spraying, girdling, or mowing.

Figure 3.—This area of nearly level Medway silt loam is used as cropland. Very steep Miamian silt loam is in the background.

Flooding severely limits most building site development and sanitary facilities.

The capability subclass is IIw. The woodland suitability subclass is 1o.

MIB—Miamian silt loam, 2 to 6 percent slopes. This gently sloping, well drained soil is in uplands. It occurs as oblong areas on rolling topography adjacent to stream terraces. Irregularly shaped areas that have longer, more even slopes are on glacial end moraines. Most areas range from 5 to 50 acres. A few range to 100 acres or more. Slopes commonly are 200 to 800 feet long.

Typically, the surface layer is brown, friable silt loam about 7 inches thick. The subsoil is about 18 inches thick. The upper part is brown, firm silty clay loam and clay, and the lower part is yellowish brown, firm clay loam. The substratum to about 60 inches is yellowish brown, firm clay loam and loam. In some areas the soils have less clay in the subsoil than is typical and are more than 40 inches thick over the calcareous, firm clay loam and loam substratum.

Included with this soil in mapping are small areas of the moderately well drained Lewisburg soils on the crest of knolls and moderately well drained Celina soils and somewhat poorly drained Crosby soils in depressions, along small drainageways, and on the lower part of slopes. Small areas of well drained Eldean soils are on end moraines. Included soils make up 5 to 15 percent of most areas.

Permeability is moderately slow in this Miamian soil, and the available water capacity is moderate. Runoff is medium. The root zone is mainly moderately deep over compact glacial till. The organic matter content is moderate. Tilth is good.

Most areas are in crops and pasture. The potential is high for crops, pasture, trees, and most recreation uses. It is medium to high for most building site development and sanitary facilities.

Crops commonly grown in the county, such as corn, soybeans, and wheat, are well suited to this soil, as are many fruits and vegetables not commonly grown. Erosion, however, is a hazard unless the surface is protected. The surface layer crusts as it dries after heavy rains. Crusting decreases the rate of water infiltration and increases runoff and erosion. Cropping systems and conservation tillage practices that keep crop residue on the surface protect the surface from the impact of raindrops and reduce crusting. The residue also slows surface runoff, increases infiltration, and reduces runoff and erosion. Adding manure and other organic residues reduces crusting and helps to maintain tilth and available water capacity. Grassed waterways should be used where water concentrates and flows in natural channels.

Pasture and hay are effective in protecting this soil from erosion. Overgrazing or grazing when the soil is too wet compacts the surface, causes poor tilth, increases runoff and erosion, and decreases plant population and vigor.

Trees grow well if competing vegetation is controlled by cutting, spraying, girdling, or mowing. Logging roads and skid trails should be protected from erosion.

This soil provides some of the best sites in the uplands for buildings (fig. 4). Runoff and erosion increase during construction. As much cover as possible should be maintained to reduce soil loss. Moderately slow permeability severely limits the use as septic tank absorption fields.

The capability subclass is IIe. The woodland suitability subclass is 1o.

MIC2—Miamian silt loam, 6 to 12 percent slopes, eroded. This sloping, well drained soil is in uplands. It occurs as long, narrow areas parallel to streams and irregularly shaped areas on end moraines. Slopes commonly are 200 to 600 feet long. Most areas range from 3 to 40 acres. A few are up to several hundred acres.

Typically, the surface layer is brown, friable silt loam about 8 inches thick. The subsoil is about 19 inches thick. The upper part is yellowish brown, friable clay loam, and the lower part is yellowish brown and dark yellowish brown, firm clay loam. The substratum to about 60 inches is brown, mottled, firm clay loam and loam. In some areas the subsoil contains less clay than is typical.

Included with this soil in mapping on the upper part of slopes are small areas of the moderately well drained Lewisburg soils and severely eroded soils that have a thinner root zone. Small areas of the somewhat poorly drained Crosby soils are along waterways and in depressions. The well drained Eldean and Kendallville soils are on end moraines. Included soils make up 5 to 15 percent of most areas.

Permeability is moderately slow in this Miamian soil, and the available water capacity is moderate. Runoff is rapid. The root zone is mainly moderately deep over compact glacial till. The organic matter content is moderately low. Tilth is good.

Most areas are in crops or pasture. The potential is medium for crops and high for pasture and trees. It is medium for most recreation uses, building site development, and sanitary facilities.

Erosion is the main hazard in cultivated areas. The silt loam surface layer crusts as it dries after heavy rains. Crusting decreases the rate of infiltration of water and increases runoff and erosion. Cropping systems and conservation tillage practices that keep crop residue on the surface protect the surface from the impact of raindrops and reduce crusting. The residue also slows surface runoff, increases infiltration, and reduces runoff and soil loss. Adding manure and other organic residues also reduces crusting and helps to maintain tilth and available water capacity. Because the surface is eroded, no-till planting may result in poor germination. Grassed waterways should be used where water concentrates and flows in natural channels.

Figure 4.—Miamian silt loam, 2 to 6 percent slopes, provides some of the best homesites in the county.

Pasture and hay help to protect this soil from erosion. Because of the erosion hazard and the moderate available water capacity, pastures should not be overgrazed. Overgrazing or grazing when the soil is wet compacts the surface, causes poor tilth, increases runoff and erosion, and decreases plant population and vigor.

This soil is suited to trees. Plant competition can be reduced by cutting, spraying, girdling, or mowing. Logging roads and skid trails should be protected against erosion. Species planted should be adapted to well drained sites.

Although the slope is a limitation, this soil is suited to most building site development. It erodes easily unless adequate cover is maintained during construction. Temporary cover should be established if the permanent cover is disturbed for extended periods. Moderately slow permeability severely limits the use as septic tank absorption fields.

The capability subclass is IIIe. The woodland suitability subclass is 1o.

MlD2—Miamian silt loam, 12 to 18 percent slopes, eroded. This moderately steep, well drained soil occurs

as long narrow areas between the gently sloping upland and stream terraces. Slopes commonly are 200 to 400 feet long. Areas commonly range from 4 to 40 acres. A few areas range to 100 acres or more.

Typically, the surface layer is brown, friable silt loam about 7 inches thick. The subsoil is dark yellowish brown and yellowish brown, firm clay loam about 22 inches thick. The substratum to about 60 inches is yellowish brown, mottled, firm loam. In some areas the subsoil contains less clay than is typical.

Included with this soil in mapping are small areas of the moderately well drained Lewisburg soils and areas of severely eroded soils. The eroded soils are commonly in areas that have been cultivated or grazed heavily. Also included are areas of the well drained Eldean soils that formed in glacial outwash on side slopes and slope breaks to the uplands. Included soils make up 5 to 15 percent of most areas.

Permeability is moderately slow in this Miamian soil, and the available water capacity is moderate. Runoff is very rapid. The root zone is mainly moderately deep over compact glacial till. The organic matter content is moderately low. Tilth is good.

Most areas are woodland or pasture. The potential is low for crops, medium for pasture and hay, and high for trees. It is low for most recreation uses, building site development, and sanitary facilities.

Slope and the severe erosion hazard are limitations for crops. Row crops can be grown occasionally if the hazard of erosion is controlled. Conservation tillage practices that keep maximum cover on the surface help to reduce runoff and erosion, maintain tilth, and increase infiltration. Adding manure and other organic residues also reduces crusting and helps to maintain tilth and available water capacity. Because the surface is eroded, no-till planting may result in poor seed germination. Grassed waterways should be used where water concentrates and flows in natural channels.

Pasture and hay help to protect the soil from erosion. Because of the erosion hazard and the moderate available water capacity, pastures should not be overgrazed. Overgrazing or grazing when the soil is wet compacts the surface, causes poor tilth, increases runoff and erosion, and decreases plant population and vigor.

This soil is suited to trees. Plant competition can be reduced by cutting, spraying, girdling, or mowing. Logging roads and skid trails should be protected against erosion. Slope limits the use of equipment for planting, maintenance, and harvesting. Species planted should be adapted to well drained sites.

The slope severely limits building site development and sanitary facilities. Runoff and erosion increase during construction. Temporary cover should be established as soon as possible to protect the surface.

The capability subclass is IVe. The woodland suitability subclass is 1r.

MIE2—Miamian silt loam, 18 to 25 percent slopes, eroded. This steep, well drained soil occurs as long narrow areas between the gently sloping upland and stream terraces. Slopes commonly are 200 to 400 feet long. Areas range from 5 to 25 acres. A few range to about 100 acres.

Typically, the surface layer is brown, friable silt loam about 7 inches thick. The subsoil is dark yellowish brown, firm clay loam about 20 inches thick. The substratum to about 60 inches is brown, firm loam. In some areas the subsoil contains less clay than is typical. In some the soil is less than 20 inches thick over the calcareous, firm loam substratum.

Included with this soil in mapping are small areas of severely eroded soils, commonly in areas that have been overgrazed or damaged by traffic in farming or other commercial activity. Included soils make up 2 to 15 percent of most areas.

Permeability is moderately slow in this Miamian soil, and the available water capacity is moderate. Runoff is very rapid. The root zone is mainly moderately deep over compact glacial till. The organic matter content is moderately low. Tilth is good.

Most areas are woodland or pasture. The potential is medium for pasture and high for trees. It is low for crops, most recreation uses, building site development, and sanitary facilities because of steep slope.

This soil is too steep for crops. The erosion hazard is severe.

This soil is suited to pasture. Pastures should not be overgrazed. Overgrazing compacts the surface, causes poor tilth, increases runoff and erosion, and decreases plant population and vigor.

This soil is suited to trees even though the slope limits the use of planting and harvesting equipment. Logging roads and skid trails should be protected from erosion. Plant competition can be reduced by cutting or spraying.

The slope severely limits recreation uses, building site development, and sanitary facilities. The soil is subject to slippage if fill is placed on the soil or if the slope is undercut.

The capability subclass is VIe. The woodland suitability subclass is 1r.

MIF—Miamian silt loam, 25 to 50 percent slopes. This very steep, well drained soil occurs as long narrow areas between the gently sloping upland and stream terraces. Slopes commonly are 200 to 400 feet long. Areas commonly range from 5 to 25 acres. A few areas range to 50 acres.

Typically, the surface layer is brown, friable silt loam about 8 inches thick. The subsoil is dark yellowish brown, firm clay loam and loam about 16 inches thick. The substratum to about 60 inches is yellowish brown, firm loam. In some areas, the subsoil contains less clay than is typical. In some the soil is less than 20 inches deep over the calcareous, firm loam substratum. In some the surface layer is darker and has a higher organic matter content than is typical.

Included with this soil in mapping are small areas of eroded soils, commonly in areas that have been

overgrazed or damaged by traffic in farming or other commercial activity. Included soils make up 2 to 10 percent of most areas.

Permeability is moderately slow in this Miamian soil, and the available water capacity is moderate. Runoff is very rapid. The root zone is mainly moderately deep over compact till. The organic matter content is moderate. Tilth is good.

This soil is too steep for use as cropland. Most areas are woodland. The potential is medium for pasture and high for trees. It is low for recreation uses, building site development, and sanitary facilities because it is very steep.

Pastures should not be overgrazed. Overgrazing compacts the surface, causes poor tilth, increases runoff and erosion, and decreases plant population and vigor.

This soil is suited to trees, but the very steep slope severely limits the use of equipment. Planting and some operations for weed control must be done by hand. Logging roads and skid trails should be protected from erosion.

The slope severely limits recreation uses, building site development, and sanitary facilities. The soil is subject to slippage if fill is placed on the soil or if the slope is undercut.

The capability subclass is VIIe. The woodland suitability subclass is 1r.

MnB—Miamian-Eldean silt loams, 2 to 6 percent slopes. This map unit consists of gently sloping, well drained soils on glacial end moraines and outwash plains in uplands. Slopes are commonly 200 to 1,200 feet long. Individual areas commonly range from 5 to 75 acres. A few areas range to several hundred acres.

Areas are 40 to 60 percent Miamian soil and 25 to 40 percent Eldean soil. The Miamian soil is on low knolls or ridges. The Eldean soil is in valleys or on plains between knolls. Areas of the two soils are so intricately mixed or are so small that it is not practical to map them separately.

Typically, the Miamian soil has a surface layer of brown, friable silt loam about 9 inches thick. The subsoil is about 22 inches thick. It is brown, firm clay loam and clay in the upper part and dark yellowish brown, firm clay loam in the lower part. The substratum to about 60 inches is yellowish brown, firm loam. In some areas the subsoil contains less clay than is typical.

Typically, the Eldean soil has a surface layer of brown, friable silt loam about 10 inches thick. The subsoil is about 26 inches thick. It is brown and dark reddish brown, firm clay loam in the upper part, and yellowish brown, friable sandy loam in the lower part. The substratum to about 60 inches is brown, loose sand. In some places depth to loose sand is more than 40 inches. In some areas the subsoil contains less clay or more gravel throughout than is typical.

Included with these soils in mapping are small areas of moderately well drained Lewisburg soils, which are commonly on crests of knolls or on long side slopes. Also included are somewhat poorly drained Crosby soils in depressions and drainageways. Included soils make up 5 to 20 percent of most areas.

Permeability is moderately slow in this Miamian soil. The available water capacity is moderate. Runoff is medium. The root zone is mainly moderately deep over compact glacial till. The organic matter content is moderate. Tilth is good.

Permeability is moderate or moderately slow in the subsoil of the Eldean soil and rapid or very rapid in the substratum. The available water capacity is low or moderate, and runoff is medium. The root zone is mainly moderately deep over loose sand and gravel. Organic matter content is moderate. Tilth is good.

Most areas are in crops or pasture. In both soils the potential is high for crops, pasture, trees, and most recreation uses. In Miamian soils the potential is medium to high for most building site development and sanitary facilities. In Eldean soils, it is high for most building site development and medium for sanitary facilities.

Crops commonly grown in the county, such as corn, soybeans, and wheat, are well suited to these soils, as are many fruits and vegetables not commonly grown. Erosion is a hazard when these soils are cropped. The surface crusts as it dries after heavy rains. Eldean soils are droughty in some years. Cropping systems and conservation tillage practices that keep crop residue on the surface protect the surface from the impact of raindrops and reduce crusting. The residue also slows surface runoff, increasing infiltration and reducing runoff and the risk of erosion. Adding manure and other organic residue reduces crusting and helps to maintain tilth and available water capacity. Grassed waterways should be used where water concentrates and flows in natural channels.

Pasture and hay are effective in protecting these soils from erosion. During dry years, summer growth is poor on Eldean soils. Pastures should not be overgrazed. Overgrazing or grazing when the soil is too wet compacts the surface, causes poor tilth, increases runoff and erosion, and reduces plant population and vigor.

Trees grow well. Species planted, however, should be adapted to dry sites. Logging roads and skid trails should be protected from erosion.

These soils provide some of the better sites in the area for building site development. Runoff and erosion increase during construction. Adequate cover should be maintained to protect the soil surface. Moderately slow permeability severely limits the use of the Miamian soil as a septic tank absorption field. The Eldean soil normally is permeable enough to function properly as a septic tank absorption field but careful location of the absorption field is needed to avoid contamination of local wells In places the Eldean soil contains sand and gravel deposits extensive enough for private use but generally not extensive enough for commercial use.

The capability subclass is IIe. The woodland suitability subclass is 1o for the Miamian soil and 2o for the Eldean soil.

MnC2—Miamian-Eldean silt loams, 6 to 12 percent slopes, eroded. This map unit consists of sloping, well drained soils on end moraines and outwash plains in uplands. Slopes commonly are 200 to 800 feet long. Areas commonly range from 5 to 30 acres.

Areas of this unit are 50 to 70 percent Miamian soil and 20 to 30 percent Eldean soil. Areas of the two soils are so intricately mixed or so small in size that it is not practical to map them separately.

Typically, the Miamian soil has a surface layer of brown, friable silt loam about 9 inches thick. The subsoil is brown and dark yellowish brown, firm clay loam about 21 inches thick. The substratum to about 60 inches is yellowish brown, firm loam. In some areas the subsoil contains less clay than is typical.

Typically, the Eldean soil has a surface layer of brown, friable silt loam about 9 inches thick. The subsoil is about 20 inches thick. It is brown and dark yellowish brown, firm clay loam in the upper part and dark yellowish brown, friable sandy clay loam in the lower part. The substratum to about 60 inches is yellowish brown, loose gravelly loamy sand. In some areas the subsoil contains less clay than is typical. In others depth to loose sand and gravel is more than 40 inches.

Included with these soils in mapping are small areas of the moderately well drained Lewisburg soils, somewhat poorly drained Crosby soils, and soils that are less than 20 inches deep over loose sand. Lewisburg soils are commonly on crests of knolls and on side slopes between the gently sloping areas above and the nearly level lower positions. Crosby soils are in depressions and drainageways. The soils that are shallow over loose sand are generally on side slopes in positions similar to those of Lewisburg soils. Included soils make up 5 to 20 percent of most areas.

Permeability is moderately slow in this Miamian soil, and the available water capacity is moderate. Runoff is rapid. The root zone is mainly moderately deep over compact till. The organic matter content is moderately low. Tilth is good.

Permeability is moderate or moderately slow in the subsoil of the Eldean soils and rapid or very rapid in the substratum. The available water capacity is low, and runoff is rapid. The root zone is mainly moderately deep over loose sand and gravel. The organic matter content is moderately low. Tilth is good.

Most areas are cropland or pasture. The potential is medium for crops and high for pasture and trees. It is medium for most recreation uses, building site development and sanitary facilities.

Crops commonly grown in the county, such as corn, soybeans, and wheat, are suited to these soils, as are many fruits and vegetables not commonly grown. Erosion, however, is a hazard if these soils are cropped. The surface crusts as it dries after heavy rains. The Eldean soil is droughty in some years. Because the available water capacity is low, the Eldean soil is better suited to early crops than to crops that mature late in summer. Cropping systems and conservation tillage practices that keep crop residue on the surface protect the surface from the impact of raindrops and reduce crusting. The residue also slows surface runoff, increases infiltration, and reduces runoff and the risk of erosion. Adding manure and other organic residues reduces crusting and helps to maintain tilth and available water capacity. Because the surface is eroded, no-till planting may result in poor germination. Grassed waterways should be used where water concentrates and flows in natural channels.

Pasture and hay help to protect the soils from erosion. Because of the erosion hazard and the moderate and low available water capacity, pastures should not be overgrazed. Overgrazing or grazing when the soil is too wet compacts the surface, causes poor tilth, increases runoff and erosion, and decreases plant population and vigor.

Productivity of woodland is high. Plant competition can be reduced by cutting, spraying, girdling, or mowing. Logging roads and skid trails should be protected against erosion. Species planted should be adapted to well drained sites. Nutrient deficiencies occur in some plants in included areas of soils that are shallow over loose sand and gravel.

Although slope is a moderate limitation, these soils are suited to most building site development. Runoff and erosion increase during construction. Temporary cover should be established as soon as possible. The Eldean soil is droughty for lawns during dry periods. Moderately slow permeability severely limits the use of the Miamian soil as a septic tank absorption field. The Eldean soil normally is permeable enough to function properly as a septic tank absorption field, but careful location of the absorption field is needed to avoid contamination of local wells. In some areas of the Eldean soil sand and gravel deposits are extensive enough for private use but generally not extensive enough for commercial use.

The capability subclass is IIIe. The woodland suitability subclass is 1o for the Miamian soil and 2o for the Eldean soil.

OdA—Odell-Lewisburg complex, 0 to 2 percent slopes. This unit consists of nearly level, somewhat poorly drained and moderately well drained soils in uplands. Areas are irregular in shape. They commonly range from 5 to 50 acres. A few range to several hundred acres.

Areas of this unit are 60 to 70 percent Odell soil and 25 to 35 percent Lewisburg soil. The Odell soil is on the lower, more nearly level areas. The Lewisburg soil is on low knolls. Areas of the two soils are so intricately mixed or so small that it is not practical to map them separately.

Typically, the Odell soil has a very dark gray, friable silty clay loam surface layer about 10 inches thick. The subsurface layer is black, friable silty clay loam about 7 inches thick. The subsoil is mottled, firm clay loam about 17 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown. The substratum to about 60 inches is yellowish brown, mottled, firm calcareous loam. In some areas, depth to calcareous material is less than 20 inches.

Typically, the Lewisburg soil has a brown, friable silt loam surface layer about 8 inches thick. The subsoil is dark yellowish brown and brown, firm clay loam about 14 inches thick. The substratum to about 60 inches is dark yellowish brown, mottled, firm calcareous loam. Some knolls are moderately eroded and have limestone fragments at the surface.

Included with these soils in mapping are the very poorly drained Kokomo soils in level areas, depressions, and waterways. Also included are the somewhat poorly drained Crosby soils, mostly on the top of knolls. Included soils make up 10 to 20 percent of most areas.

Permeability is moderately slow in this Odell soil. The available water capacity is high, and runoff is slow. A seasonal high water table is between depths of 12 and 36 inches in winter, spring, and other extended wet periods. The root zone is mainly moderately deep over compact glacial till. The organic matter content is high. Tilth is good.

Permeability is moderate or moderately slow in the subsoil and slow in the substratum in the Lewisburg soil. The available water capacity is moderate, and runoff is slow. A seasonal high water table is between 24 and 48 inches in winter, spring, and other extended wet periods. The root zone is mainly shallow over compact glacial till. The organic matter content is moderate. Tilth is good.

Most areas are in crops or pasture (fig. 5). The potential is high for crops, pasture, and trees and medium for most recreation uses. The potential is low for building site development and sanitary facilities in the Odell soil and medium in the Lewisburg soil.

Although wetness is a limitation, these soils are suited to row crops and small grain. Because the Odell soil dries and warms slowly in spring, crops are frequently damaged by excess moisture. Subsurface drainage is needed. A complete artificial drainage system is needed with the kind of conservation tillage that leaves part of the crop residue on the surface. Conservation tillage, such as chisel, disk, or rotary tillage, that incorporates part of the crop residue and leaves part on the soil surface increases the rate of water infiltration. Crop residue left on the surface holds snow cover and reduces erosion and soil blowing. No-till planting may be a good alternative if tillage is delayed because of wetness.

These soils are well suited to hay and pasture. Subsurface drainage is needed to lower the seasonal high water table in the Odell soil and is particularly important where deep rooted varieties are grown. Grazing when the soil is wet causes severe surface compaction and poor tilth and reduces plant population and vigor.

These soils are suited to trees. Shallowness over calcareous glacial till may cause nutrient deficiencies in some trees in the Lewisburg soil. Trees selected for planting on the Odell soil should tolerate some wetness. Harvesting and controlling competing vegetation should be limited to the drier periods of the year.

The Lewisburg soil is better suited than the Odell soil to building site development and sanitary facilities. Wetness is a limitation in both soils. Footing drains and basement wall coatings reduce the possibility of wet basements. Building sites should be shaped to drain surface water away from foundations.

The capability subclass is IIw. The woodland suitability subclass is 2o for the Lewisburg soil. No subclass is assigned to the Odell soil.

OdB—Odell-Lewisburg complex, 2 to 6 percent slopes. This unit consists of gently sloping, somewhat poorly drained and moderately well drained soils in uplands. Slopes commonly are 100 to 800 feet long. Areas are irregular in shape and commonly range from 5 to 30 acres.

Areas are 60 to 70 percent Odell soil and 25 to 35 percent Lewisburg soil. The Odell soil is on the lower, more nearly level areas and on foot slopes of knolls. The Lewisburg soil is on knolls that are surrounded by the Odell soil. Areas of the two soils are so intricately mixed or so small that mapping them separately is not practical.

Typically, the Odell soil has a very dark grayish brown, friable silty clay loam surface layer about 8 inches thick. The subsoil is very dark grayish brown and dark yellowish brown, mottled, firm clay loam about 25 inches thick. The substratum to about 60 inches is yellowish brown, mottled, firm calcareous loam. In some areas on the upper slopes, depth to carbonates is less than 20 inches.

Typically, the Lewisburg soil has a brown, friable silt loam surface layer about 8 inches thick. The subsoil is dark brown and brown, firm clay loam about 11 inches thick. The substratum to about 60 inches is yellowish brown, firm calcareous loam. Some knolls are moderately eroded and have limestone fragments at the surface. On these knolls, the surface layer is clay loam, and the depth to carbonates is less than 10 inches.

Included with these soils in mapping are the very poorly drained Kokomo soils along waterways and in nearly level areas and the somewhat poorly drained Crosby soils on the top of knolls. Also included are better drained soils that have a deeper root zone. Included soils make up 10 to 20 percent of most areas.

Permeability is moderately slow in this Odell soil. The available water capacity is high, and runoff is medium. A seasonal high water table is between depths of 12 and

Figure 5.—Pasture in an area of Odell soils.

36 inches in winter, spring, and other extended wet periods. The root zone is mainly moderately deep over compact glacial till. The organic matter content is high. Tilth is good.

Permeability is moderate or moderately slow in the subsoil and slow in the substratum in this Lewisburg soil. The available water capacity is moderate, and runoff is medium. A seasonal high water table is between depths of 24 and 48 inches in winter, spring, and other extended wet periods. The root zone is mainly shallow over compact glacial till. The organic matter content is moderate. Tilth is good.

Most areas are cropland or pasture. The potential is high for crops, pasture, and trees. It is medium for most recreation uses. The potential for building site development and sanitary facilities is low to medium in the Odell soil and medium in the Lewisburg soil.

These soils are suited to row crops and small grain. Erosion is a hazard unless the surface is protected. Cropping systems and conservation tillage practices that leave crop residue on the surface protect the surface from the impact of raindrops and reduce erosion. Grassed waterways are needed where water concentrates and flows in natural channels. Because the Odell soil dries and warms slowly in spring, crops are damaged by excess moisture in many years. Subsurface

drainage is needed. No-till planting may result in poor germination in eroded areas of the Lewisburg soil.

Hay and pasture are effective in protecting these soils from erosion. Subsurface drainage is needed to lower the seasonal high water table in the Odell soil, particularly where deep-rooted plants are grown. Grazing when the soil is wet causes severe surface compaction and poor tilth, increases runoff and erosion, and decreases plant population and vigor.

These soils are suited to trees. Shallowness over calcareous glacial till may cause nutrient deficiencies in some plants in the Lewisburg soil. Species selected for planting on the Odell soil should tolerate some wetness. Harvesting and controlling competing vegetation should be limited to the drier periods of the year.

The Lewisburg soil is better suited than the Odell soil to building site development and sanitary facilities. Wetness is a limitation in both soils. Footing drains and basement wall coatings reduce the possibility of wet basements. Building sites should be shaped to drain surface water away from foundations. Runoff and erosion increase during construction. Temporary cover should be established as soon as possible.

The capability subclass is IIe. The woodland subclass is 2o for the Lewisburg soil. No subclass is assigned to the Odell soil.

Pa—Patton silty clay loam. This nearly level, poorly drained soil is along small drainageways and in depressions in uplands. It is subject to ponding as a result of runoff from nearby higher areas. The slope range is 0 to 2 percent. Areas are oval or long and narrow. They commonly range from 5 to 30 acres. A few range to several hundred acres.

Typically, the surface soil is black, friable and firm silty clay loam about 14 inches thick. The subsoil is mottled, firm silty clay loam about 16 inches thick. The upper part is dark gray, and the lower part is gray and grayish brown. The substratum to about 60 inches is gray and dark gray, mottled, firm, stratified silt loam and very fine sandy loam. In some areas the subsoil contains more clay than is typical. In others it contains more sand than is typical.

Included with this soil in mapping are very poorly drained Kokomo soils and somewhat poorly drained Crosby soils. Crosby soils are better drained than this Patton soil and have a lighter colored surface layer. Kokomo and Crosby soils are underlain with glacial till. Kokomo soils are between higher adjacent upland soils and this Patton soil. In some areas, Kokomo or Crosby soils are on low knolls that are surrounded by the Patton soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately slow in this Patton soil, and the available water capacity is high or very high. Runoff is very slow or ponded. A seasonal high water table is at or near the surface in winter, spring, and other extended wet periods. The root zone is deep. The organic matter content is high. Tilth is good.

Most areas are in crops. The potential is high for crops, pasture, and trees. It is low for most recreation uses, building site development, and sanitary facilities.

Although wetness is a limitation, this soil is suited to row crops and small grain. Wetness reduces yields. The soil dries and warms slowly in spring unless artificially drained. Surface drains and grassed waterways are needed to remove ponded water, especially from wheat fields in winter and spring. Subsurface drains are also needed. A complete artificial drainage system is needed with the kind of conservation tillage that leaves part of the crop residue on the surface. Conservation tillage, such as chisel, disk, or rotary tillage, that leaves part of the crop residue on the soil surface increases the rate of water infiltration. Crop residue on the surface holds snow cover and reduces erosion and soil blowing. No-till planting may be a good alternative if tillage is delayed because of wetness.

Wetness is the main limitation for hay or pasture. Surface drains are needed where ponding is a problem. Subsurface drains are needed to lower the seasonal high water table, especially where deep-rooted plants are grown. Grazing when the soil is too wet compacts the surface severely, causes poor tilth, and reduces plant population and vigor.

This soil is suited to trees. Wet-tolerant species should be planted. Harvesting and practices for controlling competing vegetation should be limited to drier periods of the year.

Wetness and ponding severely limit most building site development. Surface drains are needed. Footing drains and basement wall coatings reduce the risk of wet basements. The included drier soils are better suited as sites for buildings. Building sites should be shaped to drain surface water away from foundations.

The capability subclass is IIw. The woodland suitability subclass is 2w.

Pg—Pits, gravel. These are areas from which gravel is taken for use in construction. They occur in pockets of glacial outwash in end moraines and in stream terraces underlain by glacial outwash. In one pit in the eastern part of the county, gravel and limestone bedrock are exposed. The limestone is crushed and used as aggregate. Gravel pits are in areas of Eldean, Westland, and other soils underlain with glacial outwash (fig. 6). Gravel pits in end moraines generally range from less than 2 acres to about 5 acres. Pits in outwash terraces generally are larger, about 2 acres to 60 acres. Some pits are mined only occasionally; others are actively mined and are being enlarged.

The material in the pits is layers of gravel and sand that vary in fragment size, orientation, thickness, and mixture. Some layers have a high percentage of silt. In some pits the rock fragments are 3 to 10 inches in diameter. They are generally round.

Figure 6.—The strata of sand and gravel in which Eldean soils develop are exposed in this gravel pit.

The gravel, sand, and larger fragments are dolomitic limestone, granite, quartz, and other siliceous material. The percentage of these components varies. The limestone is of local origin. The granite and other material was transported by glaciers from the north.

The soil material in spoil banks adjacent to the pits varies considerably within short distances. It is a mixture of overburden and loose sand and gravel. Because organic matter content and available water capacity are generally low, spoil banks are poorly suited to plants. Slope commonly ranges from 6 to 25 percent, and erosion is a hazard. Establishing vegetation on the spoil banks reduces erosion. To help establish a protective cover, side slopes should be graded and a layer of good soil material placed over the spoil material and then seeded with a cover crop.

Gravel pits with sufficient water can be developed for wildlife and recreation.

No capability subclass or woodland suitability subclass is assigned.

Rs—Ross silt loam, occasionally flooded. This well drained, nearly level soil is on flood plains along major streams. It is subject to occasional flooding. The slope range is 0 to 2 percent. Areas are oblong or long and narrow. Most range from 5 to 30 acres. A few range to 100 acres or more.

Typically, the surface soil is very dark gray, friable silt loam about 11 inches thick. The subsoil is about 33 inches thick. The upper part is very dark gray, friable silt loam, the middle part is very dark grayish brown and dark brown, firm silty clay loam, and the lower part is brown and dark yellowish brown, firm clay loam. The substratum to about 60 inches is brown, dark yellowish brown, and yellowish brown, friable and very friable loam, clay loam, and gravelly sandy loam. In some areas the dark layers are less than 20 inches thick.

Included with this soil in mapping are the moderately well drained Medway and very poorly drained Sloan soils in high water channels and shallow depressions and at the base of adjacent slopes of upland soils. Also included are areas of soils that have free carbonates throughout the soil. Included soils make up 5 to 15 percent of most areas.

Permeability is moderate in this Ross soil, and available water capacity is high or very high. Runoff is slow. A seasonal high water table is between depths of 48 and 72 inches. The root zone is deep. The organic matter content is high. Tilth is good.

Most areas are cropland or pasture. The potential is high for crops, pasture, and trees. It is medium for most recreation uses. It is low for building site development and sanitary facilities.

This soil is suited to row crops commonly grown in the county, such as corn and soybeans. Winter wheat is damaged by flooding in winter and spring in some years. Weed control may be a problem if no-till planting is used.

This soil is well suited to pasture. Pastures should not be grazed when wet. Grazing when the soil is wet compacts the surface, causes poor tilth, and reduces plant population and vigor.

Trees grow well if competing vegetation is controlled by cutting, spraying, girdling, or mowing.

Flooding severely limits building site development and sanitary facilities.

The capability subclass is IIw. The woodland suitability subclass is 1o.

So—Sloan silty clay loam, frequently flooded. This nearly level, very poorly drained soil is on flood plains. It is commonly at the base of slopes in the wider valleys and across the entire flood plain in narrow valleys. It is subject to frequent flooding from streambank overflow. The slope range is 0 to 2 percent. Individual areas are long and narrow. They commonly range from 10 to 200 acres. A few areas range to 1,000 acres or more.

Typically, the surface soil is very dark grayish brown and very dark gray, friable silty clay loam about 16 inches thick. The subsoil is firm clay loam about 26 inches thick. The upper part is mottled very dark grayish brown, and the lower part is mottled dark grayish brown and dark gray. The substratum to about 60 inches is mottled dark gray clay loam and gravelly clay loam. In some places, the very dark gray layers extend to 30 inches or more.

Included with this soil in mapping are the moderately well drained Medway and well drained Ross soils. Both soils are in slightly higher areas next to stream channels. Included soils make up 5 to 15 percent of most areas.

Permeability is moderate or moderately slow in this Sloan soil, and the available water capacity is high. Runoff is very slow or ponded. A seasonal high water table is at or near the surface in winter, spring, and other extended wet periods. The root zone is deep. The organic matter content is high. Tilth is good.

Most areas are cropland, pasture, or woodland. The potential is high for these uses. It is low for most recreation uses, building site development, and sanitary facilities.

Row crops commonly grown in the county, such as corn or soybeans, are suited to this soil. Flooding in winter and spring is long and frequent enough to damage winter wheat in most years. Wetness frequently delays fieldwork in spring. The soil warms and dries slowly unless artificially drained. In some areas, adequate outlets are not available for subsurface drainage. Surface drains are needed in these areas. A complete artificial drainage system is needed with the kind of conservation tillage that leaves part of the crop residue on the surface. Weed control may be a problem if no-till planting is used.

Pasture and hay grow well, but wetness is a limitation. Artificial drainage is needed to maintain stands of desirable species. Subsurface drainage is needed if deep-rooted plants are grown. Pastures should not be grazed when wet. Grazing when the soil is wet causes severe surface compaction and poor tilth and reduces plant population and vigor.

This soil is suited to trees that tolerate wetness. Competing vegetation can be controlled by cutting, spraying, girdling, or mowing. Controlling competing vegetation and harvesting should be limited to the drier parts of the year.

Flooding and wetness severely limit building site development and sanitary facilities.

The capability subclass is IIIw. The woodland suitability subclass is 2w.

ThA—Thackery Variant silt loam, 0 to 2 percent slopes. This nearly level, moderately well drained soil is on stream terraces or on outwash plains in uplands. Most areas are irregular in shape and range from 2 to 25 acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 11 inches thick. The subsoil is about 35 inches thick. The upper part is yellowish brown, mottled, friable silt loam. The lower part is yellowish brown and grayish brown, mottled, firm and friable clay loam, loam, and silt loam. The substratum to about 60 inches is stratified yellowish brown and grayish brown, loose gravelly sandy loam and stratified firm silt loam and silty clay loam. In some areas, the subsoil has more clay. In others, depth to the substratum is less than 40 inches. In some areas, the substratum is stratified sand and gravel.

Included with this soil in mapping are small areas of the somewhat poorly drained Crosby soils and well drained Eldean soils. Eldean soils are commonly on stream terraces. Crosby soils are commonly on outwash plains in uplands. Included soils make up 5 to 15 percent of most areas.

Permeability is moderate in the subsoil, moderately rapid or rapid in the upper part of the substratum, and slow or moderately slow in the lower part. The available water capacity is high. Runoff is slow. A seasonal high water table is between depths of 24 and 42 inches in winter, spring, and other extended wet periods. The root zone is deep. The organic matter content is moderate. Tilth is good.

Most areas are cropped. The potential is high for crops, pasture, and trees. It is medium for most recreation uses, building site development, and sanitary facilities.

This soil is suited to crops commonly grown in the county, such as corn, soybeans, and wheat. The surface crusts as it dries after heavy rains, sealing the surface and increasing runoff. Conservation tillage reduces the impact of raindrops and reduces crusting. Adding manure and other organic residues also helps to maintain tilth and reduce crusting.

This soil is well suited to pasture, but few areas are used as pasture. Overgrazing or grazing when the soil is wet compacts the surface, causes poor tilth, and decreases plant population and vigor.

The soil is suited to trees. There are no major limitations to planting or harvesting. Competing vegetation can be controlled by cutting, spraying, girdling, or mowing.

The high water table moderately limits building site development. Curtain drains and basement wall coatings reduce the possibility of wet basements. Building sites

should be shaped to drain surface water away from foundations.

The capability class is I. The woodland suitability subclass is 1o.

ThB—Thackery Variant silt loam, 2 to 6 percent slopes. This gently sloping, moderately well drained soil is on stream terraces and on outwash plains in uplands. Slopes commonly are 100 to 600 feet long. Most areas are irregular in shape and range from 2 to 35 acres.

Typically, the surface layer is brown, friable silt loam about 8 inches thick. The subsoil is about 34 inches thick. The upper part is brown and dark yellowish brown, mottled, firm clay loam. The lower part is brown, mottled, firm gravelly loam. The substratum to about 60 inches is brown, friable gravelly sandy loam and stratified grayish brown, firm silt loam and silty clay loam. In some areas the subsoil contains more clay than is typical. In others, depth to the substratum is less than 40 inches.

Included with this soil in mapping are small areas of the somewhat poorly drained Crosby soils, well drained Eldean soils, and wetter soils that formed in glacial outwash. Eldean soils are commonly on outwash plains. Crosby soils are commonly on low knolls on stream terraces. The wetter outwash soils are in depressions and along waterways. Included soils make up 5 to 15 percent of most areas.

Permeability is moderate in the subsoil, moderately rapid or rapid in the upper part of the substratum, and slow or very slow in the lower part. The available water capacity is high. Runoff is medium. A seasonal high water table is between depths of 24 and 42 inches in winter, spring, and other extended wet periods. The root zone is deep. The organic matter content is moderate. Tilth is good.

Most areas are in crops. The potential is high for crops, pasture, and trees. It is medium for most recreation uses, building site development, and sanitary facilities.

This soil is well suited to row crops and small grain. Erosion is a hazard unless the surface is protected. The surface tends to crust as it dries after heavy rains. Crusting decreases the rate of infiltration and increases runoff and erosion. Cropping systems and conservation tillage practices that keep crop residue on the surface protect the surface from the impact of raindrops and reduce crusting. The residue also slows surface runoff, increases infiltration, and reduces runoff and erosion. Adding manure and other organic residues reduces crusting and helps to maintain tilth and available water capacity. Grassed waterways are needed where water concentrates and flows in natural channels.

Pasture and hay are effective as protection against erosion. Overgrazing or grazing when the soil is wet, however, compacts the surface, causes poor tilth, increases runoff and erosion, and decreases plant population and vigor.

This soil is suited to trees. There are no major limitations to planting or harvesting trees. Competing vegetation can be controlled by cutting, spraying, girdling, or mowing.

The high water table moderately limits building site development. Curtain drains and basement wall coatings reduce the possibility of wet basements. Building sites should be shaped to drain surface water away from foundations. Runoff and erosion increase during construction. As much cover as possible should be maintained to reduce soil loss.

The capability subclass is IIe. The woodland suitability subclass is 1o.

WeA—Wea silt loam, 0 to 3 percent slopes. This nearly level, well drained soil is on glacial outwash terraces. Some areas are oblong. Some are irregular in shape. Areas range from 5 to 50 acres.

Typically, the surface soil is very dark grayish brown, friable silt loam about 14 inches thick. The subsoil is about 36 inches thick. The upper part is dark brown, firm loam, the middle part is brown, firm clay loam and sandy clay loam, and the lower part is brown and dark brown, friable sandy loam and gravelly loam. The substratum to about 60 inches is brown, loose gravelly loamy sand. In some areas depth to the substratum is less than 40 inches. In small depressions, the soil is moderately well drained.

Included with this soil in mapping are lighter colored, well drained Eldean soils on slightly raised knolls. They make up 5 to 15 percent of most areas.

Permeability is moderate in the subsoil and very rapid in the substratum. The available water capacity is moderate or high. Runoff is slow. The root zone is deep. The organic matter content is high. Tilth is good.

Most areas are in crops or pasture. The potential is high for crops, pasture, trees, most recreation uses, building site development, and sanitary facilities.

This soil is suited to crops commonly grown in the county, such as corn, soybeans, and wheat, as well as to many fruits and vegetables not commonly grown. It is one of the best soils in the county for farming. It dries and warms early in the spring, allowing early planting of most crops. It can be irrigated with few problems. Specialty crops are commonly irrigated. Early spring crops can be sprayed to protect them from frost without causing a wetness problem because the soil is well drained and moderately permeable.

This soil is well suited to pasture and hay. Overgrazing compacts the surface and reduces plant population and vigor. If deep-rooted plants, such as alfalfa, are grown, maintaining the proper pH level in the root zone is a management concern.

Woodland productivity is high if competing vegetation is controlled by cutting, spraying, girdling, or mowing. High value trees like black walnut, white ash, and yellow poplar, which grow well, are suitable for planting. There are few limitations to planting or harvesting.

This soil is well suited as sites for buildings. The very rapid permeability severely limits trench type sanitary

landfills or ponds because of seepage. Ground water supplies may be polluted by effluent from septic tank absorption fields, particularly if the absorption field is installed in included areas that are less than 40 inches deep over loose sand and gravel. The substratum is a good source of sand and gravel.

The capability class is I. No woodland suitability subclass is assigned.

Wt—Westland silty clay loam. This nearly level, very poorly drained soil is on low stream terraces and narrow valley trains and on outwash plains in uplands. It is subject to ponding as a result of runoff from adjacent soils. The slope range is 0 to 2 percent. Areas on stream terraces and valley trains are long and narrow. Some areas on outwash plains are broad. Some are irregular in shape. Areas commonly range from 10 to 100 acres.

Typically, the surface layer is very dark gray, friable silty clay loam about 10 inches thick. The subsoil is about 40 inches thick. The upper part is very dark gray, mottled, firm silty clay loam. The middle part is grayish brown and dark grayish brown, mottled, firm clay loam and loam. The lower part is grayish brown, mottled, friable gravelly loam and gravelly sandy loam. The substratum to about 60 inches is brown, loose gravelly loamy sand. In some areas, the subsoil contains more clay than is typical. In others, depth to loose sand and gravel is less than 40 inches.

Included with this soil in mapping are the very poorly drained Kokomo, poorly drained Patton, and moderately well drained Thackery Variant soils. Kokomo soils are on low knolls and are between Westland and lighter colored upland soils. Patton soils are in depressions and slack water deposits along drainageways. Thackery Variant soils are on lighter colored knolls on stream terraces. A few areas along minor streams are subject to flooding. Included soils make up 5 to 15 percent of most areas.

Permeability is moderately slow in this Westland soil, and the available water capacity is high. Runoff is very slow or ponded. A seasonal high water table is at or near the surface in winter, spring, and other extended wet periods. The root zone is deep. Organic matter content is high. Tilth is good.

Most areas are cropped. The potential is high for crops, pasture, and trees. It is low for most recreation uses, building site development, and sanitary facilities.

Although wetness is a limitation, this soil is suited to row crops and small grain. Wetness reduces yields. The soil dries slowly in spring unless artificially drained. Surface drains and grassed waterways are needed to remove ponded water, particularly where winter wheat is grown. Subsurface drainage is also needed. A complete artificial drainage system is needed with the kind of conservation tillage that leaves part of the crop residue on the surface. Conservation tillage, such as chisel, disk, or rotary tillage, that incorporates part of the crop residue and leaves part on the surface increases the rate of water infiltration. Crop residue on the surface holds snow cover and reduces erosion and soil blowing. No-till planting may be an alternative if tillage is delayed because of wetness.

Pasture and hay grow well. Wet-tolerant species should be planted. Surface drainage is needed in some areas. Subsurface drainage is needed to lower the high water table, especially where deep-rooted varieties are grown. Grazing when the soil is wet causes severe surface compaction and poor tilth and reduces plant population and vigor.

Wetness is the main limitation to growing and harvesting trees. Only the trees that tolerate wetness are suitable for planting. Harvesting and controlling competing vegetation should be limited to the drier periods of the year.

Wetness and ponding severely limit site development and sanitary facilities. Footing drains and basement wall coatings reduce the possibility of wet basements. The included drier soils are better suited as sites for buildings. Building sites should be shaped to drain surface water away from foundations.

The capability subclass is IIw. The woodland suitability subclass is 2w.

Wv—Westland silty clay loam, silty substratum. This nearly level, very poorly drained soil is on broad outwash plains and narrow stream terraces that dissect ground moraines. It is subject to ponding as a result of runoff from adjacent soils. The slope range is 0 to 2 percent. Areas commonly range from 15 to 300 acres, but the largest area is more than 1,300 acres.

Typically, the surface layer is very dark gray, friable silty clay loam about 9 inches thick. The subsurface layer is very dark gray, firm clay loam about 3 inches thick. The subsoil is about 22 inches thick. It is dark gray and grayish brown, mottled, firm clay loam in the upper part, and grayish brown, mottled, friable loam in the lower part. The substratum to about 60 inches is dark gray, very friable gravelly sandy loam and stratified brown, very friable loamy very fine sand and firm clay loam.

Included with this soil in mapping are the very poorly drained Kokomo, poorly drained Patton, and moderately well drained Thackery Variant soils. Kokomo soils occur on low knolls and between areas of the Westland and lighter colored upland soils. Patton soils are in depressions and slack water areas along drainageways. Thackery Variant soils are on lighter colored knolls. A few areas along narrow stream terraces are subject to flooding from streambank overflow. Included soils make up 5 to 15 percent of most areas.

Permeability is slow or moderately slow in this Westland soil, and the available water capacity is high. Runoff is very slow or ponded. A seasonal high water table is at or near the surface in winter, spring, and other extended wet periods. The root zone is deep. The organic matter content is high. Tilth is good.

Most areas are cropped. The potential is high for crops, pasture, and trees. It is low for most recreation uses, building site development, and sanitary facilities.

Although wetness is a limitation, this soil is suited to row crops and small grain. Yields are reduced and the soil dries slowly in the spring unless it is artificially drained. Surface drains and grassed waterways are needed to remove ponded water, particularly where winter wheat is grown. Subsurface drainage also is needed. A complete artificial drainage system is needed with the kind of tillage that leaves part of the crop residue on the surface. Conservation tillage, such as chisel, disk, or rotary tillage, that incorporates part of the crop residue and leaves part on the surface increases the rate of infiltration. Crop residue on the surface holds snow cover and reduces erosion and soil blowing. No-till planting may be an alternative if tillage is delayed because of wetness.

Pasture and hay grow well. Only wet-tolerant species should be planted. Surface drains are needed in some areas. Subsurface drainage is needed to lower the high water table, especially where deep-rooted varieties are grown. Grazing when the soil is wet causes severe surface compaction and poor tilth and reduces plant population and vigor.

Wetness is the main limitation to growing and harvesting trees. The soil is suited to trees that are adapted to wet sites. Harvesting and controlling competing vegetation should be limited to drier periods of the year.

Wetness and ponding severely limit building site development and sanitary facilities. Footing drains and basement wall coatings reduce the possibility of wet basements. The included drier soils are better suited as sites for buildings. Building sites should be shaped to drain surface water away from foundations.

The capability subclass is IIw. The woodland suitability subclass is 2w.

use and management of the soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

crops and pasture

David M. Parry, district conservationist, and Lavern M. Feusner, agronomist, Soil Conservation Service, helped prepare this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed soil map units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

More than 262,000 acres in the survey area was used for crops and pasture, according to the 1967 Conservation Needs Inventory (*5*). Of this total, about 153,000 acres was row cropped, mainly to corn and soybeans; about 28,000 acres was in close-growing crops, mainly wheat; about 38,000 acres was rotation hay and pasture; and about 28,000 acres was permanent pasture.

The potential of the soils in Madison County for grain crops and pasture is good. Production can be increased by using the information in this survey and the latest production techniques. Most of the acreage that commonly is pastured or wooded also has good potential for grain crops. Converting the small acreage now in pasture and woodland to grain production, however, would depend on economic and environmental considerations.

The acreage in crops and pasture in Madison County has not been greatly reduced by the use of land for urban development as it has in some parts of the state. About 12,000 acres in the county was urban and built-up land in 1967 (*5*). This figure increased by about 300 acres per year between 1958 and 1967.

Erosion is the major problem on about 40 percent of Madison County. Even in nearly level areas erosion can reduce productivity or interfere with fieldwork. In areas where slopes are more than 2 percent, special conservation practices are needed to hold erosion losses within limits that will not reduce productivity or increase the cost of production. Productivity is reduced if the surface layer is lost and part of the subsoil is incorporated into the plow layer. Loss of the surface layer causes poor tilth in soils that have a clayey subsoil, such as the Crosby and Lewisburg soils. Erosion also reduces productivity on soils that tend to be droughty, such as Eldean soils, because it reduces the moisture holding capacity of the soil.

Erosion increases the cost of production because many of the plant nutrients added to the soil in commercial fertilizer or in organic matter are held by the

soil particles in the surface layer. If the surface layer is eroded, these plant nutrients are removed along with the soil particles.

Erosion on farmland also results in pollution of streams by sediment and nutrients. Reducing erosion reduces the pollution of streams by sediment and improves water quality for municipal use, for recreation, and for fish and wildlife.

In many gently sloping and sloping fields, tilling and preparing a good seedbed is difficult on the more eroded spots because most of the original friable surface layer has been lost. In these spots, the reduced seed-soil contact and reduced moisture holding capacity of the soil result in poor stands. These spots are common in the eroded Miamian, Eldean, and Kendallville soils as well as in the Lewisburg soils.

Erosion control provides a protective surface cover, reduces runoff, and increases infiltration. Contour tillage, contour stripcropping, and terracing are effective erosion control practices. Slopes are so short and irregular in Madison County, however, that these practices are not practical in most areas.

A cropping system that keeps a plant cover on the soil for extended periods can hold soil losses to amounts that do not reduce the productive capacity of the soils. On livestock farms where pasture and hay are grown, the legumes and grasses in the cropping system reduce erosion, provide nitrogen, and improve tilth.

Reducing tillage and leaving crop residue on the surface increases water infiltration and reduces the hazards of runoff and erosion. These practices are suited to many of the soils in Madison County but are more difficult to use successfully on the eroded soils. Planting will be delayed on somewhat poorly drained and very poorly drained soils unless they are artificially drained. Fall tillage is suited to very poorly drained, moderately fine textured soils such as Patton silty clay loam. It provides a rough surface and a residue cover that hold snow and moisture on the surface, reducing wind erosion. In the spring this rough surface also reduces the erosion caused by runoff. The soil dries faster and early seedbed preparation is possible.

Grassed waterways reduce erosion by holding the surface soil in place and by slowing runoff. Natural drainageways are the best locations for grassed waterways. They generally require a minimum of shaping to produce a good channel. Channels should be wide and flat so that they can be easily crossed by farm machinery (fig. 7). Many areas where surface runoff is concentrated into a narrow channel or where surface runoff crosses steeper slopes can be protected by a grassed waterway.

Information on the design of erosion control practices for each kind of soil is available at the local office of the Soil Conservation Service. Current information on tillage practices is available at the local offices of the Soil Conservation Service and Cooperative Extension Service.

Drainage is needed on about 65 percent of the county. The very poorly drained Carlisle and Sloan soils are so wet that the production of crops common to the area is generally not possible unless they are artificially drained.

Other very poorly drained and poorly drained soils, including Kokomo, Patton, and Westland soils, are so wet that yields are reduced in most years unless the soils are artificially drained. If artificially drained, these soils dry out earlier in spring. Drainage also reduces the chance of delayed planting dates. Small depressional areas of these soils are subject to ponding. Ponding in these depressions may make farming impossible or may drown out crops. Grassed waterways or surface drains are needed where ponding is a problem.

The somewhat poorly drained Crosby and Odell soils dry out and warm slowly in spring unless artificially drained. Wetness delays planting and germination and reduces yields. In many years excess moisture in the root zone damages crops.

Small areas of wetter soils are commonly included in areas of Celina and Lewisburg soils along drainageways and in swales. Artificial drainage is needed in some of these wetter areas.

The design of both surface and subsurface drainage systems varies with the kind of soil and the availability of outlets. A combination of surface and subsurface drainage is needed in most areas of the very poorly drained and somewhat poorly drained soils that are row cropped intensively. Drains must be closer together in the slowly permeable soils than in the more permeable soils. Finding adequate outlets is difficult in many areas of Sloan and Carlisle soils and may be a problem in some areas of Kokomo, Patton, and Westland soils. Unless adequate outlets are available, surface drainage is an effective alternative. Information on drainage design for each kind of soil is available in the local office of the Soil Conservation Service.

Fertility is naturally low in many upland soils that have a light colored surface layer. These soils are naturally acid and may require applications of ground limestone to raise the pH level enough for good growth of alfalfa and other crops. Available phosphorus and potassium are naturally low in many of these soils. Kokomo, Patton, and Westland soils, in depressions and drainageways, are slightly acid or neutral. Medway, Ross, and Sloan soils, on flood plains, range from slightly acid to mildly alkaline and are naturally higher than most upland soils in content of plant nutrients. Additions of lime and fertilizer on all soils should be based on the results of soil tests, on the need of the crop, and on the expected level of yield. The Cooperative Extension Service can help in determining the kind and amount of fertilizer and lime needed.

Tilth is important in the germination of seeds and in the infiltration of water. Soils with good tilth are friable and porous. Maintaining tilth is a problem in many soils in Madison County.

Figure 7.—Grassed waterways protect Kokomo soils from erosion caused by runoff from surrounding areas.

The surface layer of many soils in the county is light colored silt loam and is moderate or moderately low in organic matter content. After periods of intense rainfall, it tends to crust as it dries. The crust, which is hard and nearly impervious to water, reduces infiltration and increases runoff and erosion. If these soils are plowed in fall, the surface tends to crust in winter and spring. Consequently, the plow layer is nearly as dense and hard at planting time as it was before plowing. Regular additions of crop residue, manure, and other organic material are needed to maintain good soil structure and reduce crusting.

The surface layer of Kokomo, Patton, Sloan, and Westland soils is dark colored and is higher in clay content than most soils with a light colored surface layer. These soils stay wet until late in spring in many years. If plowed when wet, they tend to be very cloddy when dry. Preparing a good seedbed is difficult in cloddy soils. These soils generally dry out earlier in spring and have better tilth if they are plowed in fall.

Field crops suited to the soils and climate of Madison County include many that are not commonly grown. Corn and soybeans are the main row crops. Grain sorghum, sunflowers, navy beans, and similar crops could be

grown if economic conditions were favorable. Wheat is the most common close-growing crop. Oats, rye, barley, and flax could be grown. Seed could be produced from bromegrass, fescue, timothy, and bluegrass and from red clover and alsike clover.

Special crops are mainly strawberries, tomatoes, sweet corn, and melons. The acreage used for such crops and other vegetables and small fruits could be increased if economic conditions were favorable.

Soils that have good natural drainage and warm early in spring, such as the Eldean soils on slopes of less than 6 percent, are especially well suited to many vegetables and small fruits. There are about 4,000 acres of these soils. Crops can generally be planted and harvested earlier on these soils than on other soils.

Latest information and suggestions on growing special crops can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

Permanent pasture makes up about 10 percent of Madison County. It is supplemented with a large amount of livestock forage produced by meadow crops. Some permanent pastures are on eroded soils that formerly were cultivated or on narrow strips and irregular areas of soils that are frequently flooded. Many areas that support scattered oak and hickory trees and are also pastured produce significant amounts of high quality forage. Permanent pastures near farmsteads are often used as feedlots or access lanes.

Yields of permanent pasture vary greatly, but most soils in the county could produce high quality permanent pasture. Sloping to steep soils, such as the Eldean, Kendallville, and Miamian soils, are commonly eroded and low in fertility and have less water available to plants. Forage production on these soils is less than on other soils. Growth is good on the gently sloping upland and terrace soils, but erosion is a hazard if the plant cover is damaged by overgrazing. Severe soil compaction occurs if livestock graze and trample these soils during wet periods. The poorly drained and very poorly drained Kokomo, Patton, and Westland soils produce large amounts of forage. Subsurface drainage is needed, however, for optimum growth. It is also needed to keep desirable species from drowning out. Grazing during wet periods should be avoided.

The Medway, Ross, and Sloan soils are potentially well suited to permanent pasture. Flooding that would damage cash crops during the growing season is much less damaging to permanent pasture. These alluvial soils are fertile, have a high or very high available water capacity, and are capable of producing good grass or grass-legume pastures. Artificial drainage is needed on the very poorly drained Sloan soils, particularly where legumes are grown. Drainage is generally not needed on the better drained Medway and Ross soils.

Management of permanent pasture is similar to that of cropland. Lime and fertilizer should be applied according to the results of soil tests. Controlling weeds by periodic clipping and by applying herbicides encourages the growth of desirable pasture plants. Seeding the right mixture at the right time and deferred grazing are needed to maintain well established permanent pasture. The latest information on seeding mixtures, herbicide application, and other management can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

land capability classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit (*7*). Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, woodland, wildlife habitat, or recreation.

The acreage of soils in each capability class and subclass is shown in table 6. The capability classification of each map unit is given in the section "Detailed soil map units."

woodland management and productivity

When the first settlers arrived, most of Madison County was wooded except for numerous prairie openings. Trees were mostly hardwoods. Today, after a century and a half of agricultural development, only 4.5 percent of the county is wooded (*5*). Most of this acreage is small scattered woodlots in the steeper areas along stream valleys and on flood plains. Some small scattered woodlots are on the very poorly drained soils on uplands. Repeated cutting of the best trees has downgraded the quality of the woodland. Only the unmarketable and damaged trees remain. Many woodlots are grazed and therefore are not reforested naturally.

Woodland should be protected from grazing and fire. Grazing by livestock damages new growth on existing trees and increases the mortality rate of seedlings. Selective cutting should remove the less desirable species. Species selected for planting should be adapted to the soils.

Information on forest management is available from the Cooperative Extension Service, the Ohio Department of Natural Resources, Division of Forestry, the Agricultural Stabilization and Conservation Service, and the Soil Conservation Service.

Table 7 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination (woodland suitability) symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for important trees. The number 1 indicates very high productivity; 2, high; 3, moderately high; 4, moderate; and 5, low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *x* indicates stoniness or rockiness; *w*, excessive water in or on the soil; *t*, toxic substances in the soil; *d*, restricted root depth; *c*, clay in the upper part of the soil; *s*, sandy texture; *f*, high content of coarse fragments in the soil profile; and *r*, steep slopes. The letter *o* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: x, w, t, d, c, s, f, and r.

In table 7, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Ratings of the *erosion hazard* indicate the risk of loss of soil in well managed woodland. The risk is *slight* if the expected soil loss is small, *moderate* if measures are needed to control erosion during logging and road construction, and *severe* if intensive management or special equipment and methods are needed to prevent excessive loss of soil.

Ratings of *equipment limitation* reflect the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. A rating of *slight* indicates that use of equipment is not limited to a particular kind of equipment or time of year; *moderate* indicates a short seasonal limitation or a need for some modification in

management or in equipment; and *severe* indicates a seasonal limitation, a need for special equipment or management, or a hazard in the use of equipment.

Seedling mortality ratings indicate the degree to which the soil affects the mortality of tree seedlings. Plant competition is not considered in the ratings. The ratings apply to seedlings from good stock that are properly planted during a period of sufficient rainfall. A rating of *slight* indicates that the expected mortality is less than 25 percent; *moderate*, 25 to 50 percent; and *severe*, more than 50 percent.

Ratings of *windthrow hazard* are based on soil characteristics that affect the development of tree roots and the ability of the soil to hold trees firmly. A rating of *slight* indicates that a few trees may be blown down by strong winds; *moderate*, that some trees will be blown down during periods of excessive soil wetness and strong winds; and *severe*, that many trees are blown down during periods of excessive soil wetness and moderate or strong winds.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index*. This index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

Trees to plant are those that are suited to the soils and to commercial wood production.

windbreaks and environmental plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 8 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 8 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens.

Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

recreation

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

Camp areas require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking, horseback riding, and bicycling should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

wildlife habitat

Under good management, including erosion control, all the soils in Madison County are suited to plants commonly grown to provide food and shelter for wildlife. The wildlife most likely to be found in Madison County are cottontail, woodchuck, fox squirrel, gray squirrel, mourning dove, muskrat, opossum, pheasant, raccoon, red fox, skunk, songbirds, such as indigo bunting, cat bird, and cedar waxwing, and white-tailed deer.

Habitat for wetland wildlife can easily be developed in marshy areas. Most marshy areas are in very poorly drained upland depressions and in old stream meanders on flood plains (fig. 8). Special plantings around ponds or marshy areas attract waterfowl. Wooded areas, commonly nearby, attract other kinds of wildlife. Ponds can be built at suitable sites. Wildlife meadow mixtures and shrubs that provide food can be planted around ponds. Hedgerows and brushy fence rows can enclose the area.

Woodlots and small clearings in large wooded areas attract wildlife. Windbreaks around farmsteads and livestock areas can provide good habitat if they include plantings that provide food and shelter. Birdhouses, seed crops, and flowers attract songbirds.

For information on how to increase the wildlife on your property, contact your local game protector, the county agricultural extension service, or a representative of the Soil Conservation Service.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 10, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor (*1*). A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, timothy, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are foxtail, goldenrod, smartweed, ragweed, and fescue.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of

Figure 8.—Sloan silty clay loam provides good habitat for wetland wildlife.

hardwood trees and shrubs are depth of the root zone, the available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, maple, beech, hawthorn, dogwood, hickory, hackberry, and black walnut. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are shrub honeysuckle, autumn-olive, and crabapple.

Coniferous plants furnish browse, seeds, and cones. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine and spruce.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are duckweed, wild millet, willow, reed canarygrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and shallow ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field

sparrow, cottontail, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, and deer.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, and mink.

engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

building site development

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high

water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

sanitary facilities

Table 12 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 12 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to effectively filter the effluent. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

construction materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table,

rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

water management

Table 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed excavated ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

soil properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 18.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

engineering index properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil series and their morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains particles coarser than sand, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*3*) and the system adopted by the American Association of State Highway and Transportation Officials (*2*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 18.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

physical and chemical properties

Table 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 16, the estimated content of organic matter of the plow layer is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

soil and water features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes is not considered flooding.

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered is local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are the depth to the seasonal high water table; the kind of water table—that is,

perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 17.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An artesian water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A perched water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations generally can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavations.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate,* or *high,* is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

physical and chemical analyses of selected soils

Several soils in Madison County were sampled and laboratory data determined by the Soil Characterization Laboratory, Department of Agronomy, Ohio State University, Columbus, Ohio. The physical and chemical data obtained on most samples include particle size distribution, reaction, organic matter content, calcium carbonate equivalent, and extractable cations.

These data were used in the classification and correlation of these soils and in evaluating their behavior under various land uses. Five profiles selected as representative of the respective series are described in the section "Soil series and their morphology" of this publication. These series and their laboratory indentification numbers are: Crosby (Ma-15), Eldean (Ma-14), Lewisburg (Ma-17), Odell (Ma-19), and Westland (Ma-22).

In addition to the Madison County data, laboratory data are also available from nearby counties with many of the same kinds of soils. All are on file at the Department of Agronomy, Ohio State University, Columbus, Ohio; the Ohio Department of Natural Resources, Division of Lands and Soil; and the Soil Conservation Service, State Office, Columbus, Ohio.

engineering index test data

Table 18 shows laboratory test data for two pedons sampled at carefully selected sites in the survey area. The pedons are typical of the series and are described in the section "Soil series and their morphology." The soil samples were tested by the State of Ohio, Department of Transportation, Division of Highways, Testing Laboratory.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are: AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); Moisture density, Method A—T 99 (AASHTO), D 698 (ASTM).

classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*8*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 19, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Alfisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aqualf (*Aqu*, meaning water, plus *alf*, from Alfisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Ochraqualfs (*Ochr*, meaning light colored surface layer, plus *aqualf*, the suborder of the Alfisols that have an aquic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Aeric* identifies the subgroup that is drier than the typical great group. An example is Aeric Ochraqualfs.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine, mixed, mesic Aeric Ochraqualfs.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

soil series and their morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (*6*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*8*). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed soil map units."

Carlisle series

The Carlisle series consists of very poorly drained soils on flood plains and in upland depressions. These soils formed in organic material. Permeability is moderately rapid to moderately slow. The slope range is 0 to 2 percent.

Carlisle soils are near Kokomo, Miamian, and Sloan soils. Kokomo and Miamian soils formed in glacial till. Miamian soils are well drained. Sloan soils formed in alluvial material.

Typical pedon of Carlisle muck, Pike Township, 12.2 miles west of Plain City, 0.6 mile north of the intersection of Irwin Road and Van Ness Road along Irwin Road, then 395 yards west:

Oa1—0 to 12 inches; black (10YR 2/1) broken face and rubbed sapric material; about 2 percent fiber, less than 1 percent rubbed; weak very coarse subangular blocky structure parting to moderate coarse granular; friable; common roots; 50 percent mineral; slightly acid; abrupt smooth boundary.

Oa2—12 to 22 inches; dark brown (7.5YR 3/2) broken face, dark reddish brown (5YR 2/2) rubbed sapric material; about 10 percent fiber, 3 percent rubbed; massive; friable; few roots; 25 percent mineral; slightly acid; gradual wavy boundary.

Oa3—22 to 35 inches; dark reddish brown (5YR 2/2) broken face and rubbed sapric material; about 25 percent fiber, 6 percent rubbed; massive; friable; common woody fragments; 20 percent mineral; neutral; clear wavy boundary.

Oa4—35 to 46 inches; dark reddish brown (5YR 2/2) broken face and rubbed sapric material; about 30 percent fiber, 8 percent rubbed; massive; friable; common woody fragments; 15 percent mineral; neutral; gradual wavy boundary.

Oa5—46 to 54 inches; dark reddish brown (5YR 3/2) broken face, dark reddish brown (5YR 2/2) rubbed sapric material; about 20 percent fiber, 6 percent rubbed; massive; friable; common woody fragments; 10 percent mineral; neutral; gradual wavy boundary.

Lco—54 to 60 inches; dark gray (10YR 4/1) coprogenous earth; massive; friable; common shell fragments; slight effervescence; mildly alkaline.

The thickness of the organic material is 52 inches or more. Rubbed colors may differ from broken colors by 1 or 2 units.

The surface tier has hue of 10YR or is neutral. Value is 2. Chroma is 0 or 1. Reaction ranges from slightly acid to mildly alkaline.

The subsurface tier has hue of 5YR through 10YR, value of 2 or 3, and chroma of 1 or 2. Reaction ranges from medium acid to mildly alkaline.

The bottom tier has hue of 5YR through 10YR, value of 2 or 3, and chroma of 1 or 2. Reaction is neutral or mildly alkaline.

Celina series

The Celina series consists of moderately well drained soils on upland side slopes. These soils formed in glacial till. Permeability is moderately slow. The slope range is 2 to 6 percent.

Celina soils are similar to Lewisburg, Miamian, and Thackery Variant soils and are commonly near Kokomo, Crosby, and Lewisburg soils. Kokomo soils are very poorly drained and have a mollic epipedon. Crosby soils are somewhat poorly drained. Lewisburg soils have a 12- to 22-inch solum. Miamian soils are well drained. Thackery Variant soils, which formed in glacial outwash, are less clayey in the subsoil than Celina soils.

Typical pedon of Celina silt loam in an area of Lewisburg-Celina silt loams, 2 to 6 percent slopes, Canaan Township, 3.4 miles south of Plain City, 1.1 miles north of the intersection of Plain City-Georgesville Road and Price-Hilliards Road along Plain City-Georgesville Road, then 835 yards west:

Ap—0 to 9 inches; brown (10YR 4/3) silt loam; moderate medium granular structure; friable; common roots; 2 percent pebbles; medium acid; abrupt smooth boundary.

B21t—9 to 14 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; firm; few roots; patchy brown (10YR 4/3) clay films on horizontal and vertical faces of peds; 4 percent pebbles; slightly acid; clear wavy boundary.

B22t—14 to 20 inches; yellowish brown (10YR 5/4) clay loam; common fine distinct dark grayish brown (10YR 4/2) and common fine faint yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; few roots; patchy dark yellowish brown (10YR 4/4) clay films on horizontal and vertical faces of peds; common dark concretions (iron and manganese oxides); 4 percent pebbles; neutral; gradual wavy boundary.

B23t—20 to 26 inches; yellowish brown (10YR 5/4) clay loam; common fine distinct grayish brown (10YR 5/2) and common fine faint yellowish brown (10YR 5/6) mottles; moderate coarse subangular blocky structure; firm; few roots; very patchy dark yellowish brown (10YR 4/4) clay films on horizontal and vertical faces of peds; common dark concretions (iron and manganese oxides); 6 percent pebbles; neutral; gradual wavy boundary.

C1—26 to 32 inches; yellowish brown (10YR 5/4) clay loam; common medium distinct grayish brown (10YR 5/2) and common medium faint yellowish brown (10YR 5/6) mottles; massive; firm; 10 percent pebbles; strong effervescence; moderately alkaline; clear wavy boundary.

C2—32 to 54 inches; yellowish brown (10YR 5/4) loam; common medium distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; massive; firm; 12 percent pebbles; strong effervescence; moderately alkaline; clear wavy boundary.

C3—54 to 60 inches; brown (10YR 5/3) loam; massive; firm; 12 percent pebbles; strong effervescence; moderately alkaline.

Thickness of the solum ranges from 20 to 40 inches. Depth to carbonates ranges from 18 to 40 inches.

The A horizon has dominant hue of 10YR, value of 4 or 5, and chroma of 2 or 3. Reaction is medium acid to neutral.

The B horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4. Texture is commonly clay loam or clay. In some pedons individual subhorizons are silty clay loam. Reaction ranges from medium acid to mildly alkaline.

The C horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. Texture is dominantly loam, but in

some pedons the upper part is clay loam. Reaction is mildly alkaline or moderately alkaline.

Crosby series

The Crosby series consists of somewhat poorly drained, slowly permeable soils on uplands. These soils formed in glacial till. The slope range is 0 to 6 percent.

Crosby soils are commonly near Kokomo, Lewisburg, and Odell soils. Kokomo and Odell soils have a mollic epipedon. Kokomo soils are very poorly drained. Lewisburg soils are better drained than Crosby soils and do not have mottles just below the A horizon.

Typical pedon of Crosby silt loam in an area of Crosby-Lewisburg silt loams, 0 to 2 percent slopes, Pleasant Township, 3.9 miles north-northwest of Mt. Sterling, 0.5 mile south of the intersection of Woods Opossum Run Road and Anderson-Antioch Road along Woods-Opossum Run Road, then 140 yards west:

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) silt loam; moderate medium granular structure; friable; many roots; few pebbles; slightly acid; abrupt smooth boundary.

B1—10 to 16 inches; brown (10YR 5/3) clay loam; common fine faint grayish brown (10YR 5/2) and yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; firm; common roots; patchy grayish brown (10YR 5/2) silt coatings on vertical and horizontal faces of peds; few pebbles; medium acid; clear wavy boundary.

B21t—16 to 21 inches; brown (10YR 4/3) clay loam; common fine distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; few roots; patchy grayish brown (10YR 5/2) clay films on vertical and horizontal faces of peds; common dark concretions (iron and manganese oxides); few pebbles; medium acid; clear wavy boundary.

B22t—21 to 27 inches; dark yellowish brown (10YR 4/4) clay loam; common fine distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; firm; few roots; patchy dark grayish brown (10YR 4/2) clay films on vertical and horizontal faces of peds; many dark concretions (iron and manganese oxides); 5 percent pebbles; neutral; gradual wavy boundary.

B23t—27 to 31 inches; brown (10YR 4/3) clay loam; common fine distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; firm; few roots; patchy grayish brown (10YR 5/2) clay films on vertical and horizontal faces of peds; few dark concretions (iron and manganese oxides); 5 percent pebbles; mildly alkaline; clear wavy boundary.

C1—31 to 43 inches; yellowish brown (10YR 5/4) loam; common medium faint grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; massive; firm; 12 percent pebbles; slight effervescence; mildly alkaline; gradual wavy boundary.

C2—43 to 55 inches; yellowish brown (10YR 5/4) loam; few coarse distinct gray (10YR 5/1) mottles; massive; firm; 12 percent pebbles; slight effervescence; mildly alkaline; gradual wavy boundary.

C3—55 to 60 inches; yellowish brown (10YR 5/4) loam; massive; firm; 14 percent pebbles; slight effervescence; mildly alkaline.

Solum thickness ranges from 20 to 40 inches. Depth to carbonates ranges from 18 to 36 inches.

The A horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. Reaction ranges from medium acid to neutral.

The B horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. Texture is clay loam or silty clay loam. In places individual subhorizons are clay. Reaction ranges from strongly acid to mildly alkaline.

The C horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. Reaction is mildly alkaline or moderately alkaline.

Eldean series

The Eldean series consists of well drained soils on stream terraces, end moraines, and outwash plains. These soils formed in stratified sand and gravel deposits. The subsoil is moderately or moderately slowly permeable, and the substratum is rapidly or very rapidly permeable. The slope range is 0 to 12 percent.

Eldean soils are commonly near Kendallville and Miamian soils on the uplands and Medway, Ross, and Westland soils on flood plains and terraces. Kendallville and Miamian soils have till in the substratum. Medway, Ross, and Westland soils have a mollic epipedon. Medway soils are moderately well drained, and Westland soils are very poorly drained.

Typical pedon of Eldean silt loam, 2 to 6 percent slopes, Pleasant Township, 3.5 miles northwest of Mt. Sterling, 1,300 yards northeast of the intersection of Junk Road and State Route 56:

Ap—0 to 10 inches; brown (10YR 4/3) silt loam; moderate medium granular structure; friable; many roots; 4 percent pebbles; neutral; clear wavy boundary.

B1—10 to 16 inches; brown (7.5YR 5/4) loam; moderate fine and medium subangular blocky structure; friable; common roots; patchy brown (7.5YR 4/4) silt coatings on vertical and horizontal faces of peds; 8 percent pebbles; slightly acid; clear wavy boundary.

B21t—16 to 24 inches; brown (7.5YR 4/4) clay loam; moderate fine and medium subangular blocky structure; firm; few roots; patchy reddish brown (5YR 4/4) clay films on vertical and horizontal faces of

peds; 10 percent pebbles; neutral; clear wavy boundary.

B22t—24 to 28 inches; reddish brown (5YR 4/4) clay; moderate medium subangular blocky structure; firm; few roots; continuous reddish brown (5YR 4/3) clay films on vertical and horizontal faces of peds; 10 percent pebbles; neutral; gradual wavy boundary.

B3—28 to 36 inches; brown (7.5YR 4/4) gravelly loam; weak coarse subangular blocky structure; friable; few roots; very patchy reddish brown (5YR 4/3) silt coatings on vertical and horizontal faces of peds; many fine very pale brown weathered limestone fragments; 45 percent pebbles; slight effervescence; mildly alkaline; clear wavy boundary.

C—36 to 60 inches; brown (10YR 5/3) very gravelly coarse sandy loam; single grained; loose; 70 percent pebbles; strong effervescence; moderately alkaline.

Solum thickness ranges from 20 to 40 inches. Depth to carbonates ranges from 18 to 36 inches.

The A horizon has hue of 10YR, value of 4, and chroma of 2 or 3. Reaction ranges from medium acid to neutral.

The B horizon has hue of 10YR, 7.5YR, or 5YR, value of 3 to 5, and chroma of 3 or 4. Texture in the B1 and B2 horizons is loam, clay loam, clay, or silty clay loam. The B3 horizon has texture of clay loam, loam, sandy loam, sandy clay loam, or their gravelly analogs. Reaction ranges from medium acid to neutral in the upper part of the B horizon and from slightly acid to mildly alkaline in the lower part. Some pedons are moderately alkaline in the B3 horizon.

The C horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. Texture is gravelly loamy sand, very gravelly coarse sandy loam, or gravelly sand. Reaction is mildly alkaline or moderately alkaline.

Kendallville series

The Kendallville series consists of well drained soils on uplands adjacent to stream terraces and on end moraines. These soils formed in glacial outwash over glacial till. Permeability is moderately slow. The slope range is 2 to 12 percent.

Kendallville soils are similar to Eldean, Lewisburg, and Miamian soils and are commonly near Celina, Eldean, Lewisburg, and Miamian soils. Celina, Eldean, Lewisburg, and Miamian soils have more clay in the subsoil than the Kendallville soils. Eldean soils also have glacial outwash in the substratum. Celina soils are wetter.

Typical pedon of Kendallville silt loam, 2 to 6 percent slopes, Pleasant Township, 1 mile southeast of Mount Sterling, 0.4 mile south of the intersection of Clarks Run Road and State Route 56 (in Pickaway County) along Clarks Run Road, then 970 yards west:

Ap—0 to 8 inches; brown (10YR 4/3) silt loam; moderate medium granular structure; friable; common roots; few pebbles; neutral; abrupt smooth boundary.

B1—8 to 13 inches; brown (7.5YR 5/4 and 4/4) clay loam; moderate fine and medium subangular blocky structure; friable; few roots; patchy brown (7.5YR 4/2) silt coatings on horizontal and vertical faces of peds; 5 percent pebbles; medium acid; clear wavy boundary.

B21t—13 to 18 inches; brown (7.5YR 5/4) clay loam; moderate medium subangular blocky structure; firm; few roots; patchy brown (7.5YR 4/4) clay films on horizontal and vertical faces of peds; 4 percent pebbles; medium acid; clear wavy boundary.

B22t—18 to 26 inches; brown (7.5YR 5/4) clay loam; moderate medium subangular blocky structure; firm; few roots; patchy reddish brown (5YR 5/4) clay films on horizontal and vertical faces of peds; 10 percent pebbles; medium acid; clear wavy boundary.

B23t—26 to 33 inches; brown (7.5YR 5/4) clay loam; weak medium prismatic structure parting to moderate medium subangular blocky; firm; few roots; patchy brown (7.5YR 4/4) clay films on horizontal and vertical faces of peds; 10 percent pebbles; medium acid; clear wavy boundary.

IIB24t—33 to 36 inches; yellowish brown (10YR 5/4) clay loam; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; few roots; patchy brown (7.5YR 4/4) clay films on horizontal and vertical faces of peds; 8 percent pebbles; neutral; abrupt wavy boundary.

IIC—36 to 60 inches; yellowish brown (10YR 5/4) loam; massive; firm; 12 percent pebbles; strong effervescence; moderately alkaline.

Solum depth ranges from 25 to 40 inches. The depth to carbonates ranges from 20 to 40 inches.

The Ap horizon is neutral or slightly acid.

The B horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4. Texture is silt loam or clay loam. The B horizon is medium or strongly acid in the upper part and increases to neutral or mildly alkaline in the lower part.

The C horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. Reaction is mildly alkaline or moderately alkaline.

Kokomo series

The Kokomo series consists of very poorly drained soils in upland depressions. These soils formed in glacial till. Permeability is moderately slow. The slope range is 0 to 2 percent.

Kokomo soils are commonly near Crosby and Odell soils. Crosby soils are somewhat poorly drained, have an ochric epipedon, and are on low knolls. Odell soils are somewhat poorly drained and are on low knolls or side slopes adjacent to Kokomo soils.

Typical pedon of Kokomo silty clay loam, Canaan Township, 3.4 miles south of Plain City, 1.1 miles north of the intersection of Plain City-Georgesville Road and Price-Hilliards Road along Plain City-Georgesville Road, then 945 yards west:

Ap—0 to 10 inches; very dark gray (10YR 3/1) silty clay loam; gray (10YR 5/1) dry; moderate medium granular structure; friable; many roots; few pebbles; slightly acid; abrupt smooth boundary.

B21t—10 to 18 inches; very dark grayish brown (10YR 3/2) clay loam; grayish brown (10YR 5/2) dry; common fine distinct yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; firm; common roots; very patchy very dark gray (10YR 3/1) clay films on vertical and horizontal faces of peds; patchy very dark gray (10YR 3/1) silty organic coatings on horizontal and vertical faces of peds; few dark concretions (iron and manganese oxides); few pebbles; slightly acid; abrupt wavy boundary.

B22tg—18 to 26 inches; dark grayish brown (10YR 4/2) clay loam; common medium distinct yellowish brown (10YR 5/4 and 5/6) mottles; moderate medium subangular blocky structure; firm; few roots; very patchy very dark gray (10YR 3/1) clay films on vertical and horizontal faces of peds; patchy very dark gray (10YR 3/1) silt coatings on vertical faces of peds and patchy grayish brown (10YR 5/2) silt coatings on vertical and horizontal faces of peds; few dark concretions (iron and manganese oxides); 4 percent pebbles; slightly acid; gradual wavy boundary.

B3tg—26 to 32 inches; grayish brown (10YR 5/2) clay loam; common fine distinct yellowish brown (10YR 5/4 and 5/6) mottles; moderate medium subangular blocky structure; firm; few roots; very patchy grayish brown (10YR 5/2) clay films on vertical faces of peds; very patchy grayish brown (10YR 5/2) silt coatings on vertical and horizontal faces of peds; few dark concretions (iron and manganese oxides); 4 percent pebbles; neutral; clear wavy boundary.

C1g—32 to 42 inches; grayish brown (10YR 5/2) loam; common medium distinct yellowish brown (10YR 5/4 and 5/6) mottles; massive; firm; common fine prominent white (10YR 8/1) weathered limestone fragments; 10 percent pebbles; slight effervescence; mildly alkaline; clear wavy boundary.

C2g—42 to 56 inches; gray (10YR 5/1) loam; common medium distinct yellowish brown (10YR 5/4 and 5/6) mottles; massive; firm; 12 percent pebbles; slight effervescence; mildly alkaline; gradual wavy boundary.

C3g—56 to 60 inches; gray (10YR 5/1) loam; common coarse distinct yellowish brown (10YR 5/4) mottles; massive; firm; 12 percent pebbles; slight effervescence; mildly alkaline.

Solum thickness ranges from 30 to 50 inches. Thickness of the mollic epipedon ranges from 11 to 18 inches.

The mollic epipedon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. Texture is commonly silty clay loam or clay loam. Reaction is slightly acid or neutral.

The B horizon below the mollic epipedon has hue of 10YR, 2.5Y, or 5Y, value of 4 to 6, and chroma of 1 or 2. Texture is commonly clay loam or silty clay loam. Reaction ranges from slightly acid to mildly alkaline.

The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 to 4. Texture is clay loam or loam. Reaction is mildly alkaline or moderately alkaline.

Lewisburg series

These moderately well drained soils are commonly on low knolls and gentle side slopes of the uplands. They formed in loamy calcareous glacial till. Permeability is moderate or moderately slow over slow. The slope range is 0 to 6 percent.

Lewisburg soils are similar to Celina, Kendallville, and Miamian soils and are commonly near Celina, Crosby, and Odell soils. Celina, Kendallville, and Miamian soils have a thicker solum than Lewisburg soils. Crosby and Odell soils are wetter and have mottles just below the A horizon. Odell soils also have a mollic epipedon. Kendallville soils, which formed in glacial outwash over glacial till, have a lower clay content in the argillic horizon.

Typical pedon of Lewisburg silt loam in an area of Crosby-Lewisburg silt loams, 2 to 6 percent slopes, Pleasant Township, 3.4 miles north of Mount Sterling, 0.2 mile northwest of the intersection of Kiousville-Palestine Road and Anderson-Antioch Road along Kiousville-Palestine Road, then 310 yards west:

Ap—0 to 9 inches; brown (10YR 4/3) silt loam; moderate medium granular structure; friable; many roots; few pebbles; neutral; abrupt smooth boundary.

B2t—9 to 15 inches; dark yellowish brown (10YR 4/4) clay loam; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; common roots; patchy dark yellowish brown (10YR 4/4) clay films on horizontal and vertical faces of peds; 5 percent pebbles; slightly acid; abrupt wavy boundary.

B3t—15 to 21 inches; yellowish brown (10YR 5/4) clay loam; moderate coarse subangular blocky structure; firm; few roots; patchy dark yellowish brown (10YR 4/4) clay films on horizontal and vertical faces of peds; common light gray (10YR 7/1) weathered limestone fragments; 8 percent pebbles; slight effervescence; mildly alkaline; clear wavy boundary.

C1—21 to 33 inches; yellowish brown (10YR 5/4) loam; few fine distinct light brownish gray (10YR 6/2) mottles; massive; firm; 12 percent pebbles; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—33 to 45 inches; yellowish brown (10YR 5/4) loam; common medium distinct light brownish gray (10YR 6/2) mottles; massive; firm; 12 percent pebbles; strong effervescence; moderately alkaline; gradual wavy boundary.
C3—45 to 60 inches; yellowish brown (10YR 5/4) loam; massive; firm; 12 percent pebbles; strong effervescence; moderately alkaline.

Solum depth ranges from 12 to 22 inches. Depth to carbonates ranges from 10 to 18 inches.

The A horizon has hue of 10YR, value of 4, and chroma of 2 or 3. Texture is dominantly silt loam but is clay loam in some pedons. Reaction ranges from medium acid to neutral.

The B horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4. Texture is clay loam, clay, or silty clay loam. Reaction ranges from medium acid to mildly alkaline.

The C horizon has hue of 10YR, value of 5, and chroma of 3 or 4. Reaction is mildly alkaline or moderately alkaline.

Medway series

The Medway series consists of moderately well drained, moderately permeable soils on flood plains along major streams. These soils formed in recent alluvium from upland soils. The slope range is 0 to 2 percent.

Medway soils are commonly near Eldean, Ross, Sloan, and Westland soils. Eldean soils are well drained and have an ochric epipedon. Sloan and Westland soils are very poorly drained. Ross soils are well drained and have a mollic epipedon thicker than 24 inches.

Typical pedon of Medway silt loam, occasionally flooded, Oak Run Township, 6.5 miles north-northwest of Mount Sterling, 1.7 miles southeast of the intersection of State Route 56 and Moorman Road along State Route 56, then 1,935 yards northeast:

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam; dark grayish brown (10YR 4/2) dry; moderate fine and medium granular structure; friable; common roots; few pebbles; mildly alkaline; abrupt smooth boundary.
A12—9 to 15 inches; very dark gray (10YR 3/1) silt loam; dark grayish brown (10YR 4/2) dry; moderate medium granular structure; friable; few roots; patchy very dark gray (10YR 3/1) silt coatings on vertical and horizontal faces of peds; few pebbles; mildly alkaline; clear wavy boundary.
B1—15 to 21 inches; dark grayish brown (10YR 4/2) silt loam; few fine faint brown (10YR 4/3) mottles; moderate medium subangular blocky structure; friable; few roots; patchy very dark gray (10YR 3/1) silt coatings on vertical and horizontal faces of peds; few pebbles; mildly alkaline; clear wavy boundary.
B2—21 to 27 inches; brown (10YR 4/3) clay loam; few medium distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; firm; few roots; very patchy very dark gray (10YR 3/1) and patchy dark grayish brown (10YR 4/2) silt coatings on vertical and horizontal faces of peds; few pebbles; mildly alkaline; gradual wavy boundary.
B3—27 to 34 inches; brown (10YR 4/3) loam; common fine distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; firm; few roots; patchy dark grayish brown (10YR 4/2) silt coatings on vertical and horizontal faces of peds; few fine light gray (10YR 7/1) weathered limestone fragments; 5 percent pebbles; slight effervescence; mildly alkaline; clear wavy boundary.
C1—34 to 46 inches; grayish brown (10YR 5/2) gravelly loam; common fine faint brown (10YR 5/3) and common fine distinct yellowish brown (10YR 5/6) mottles; massive; firm; common fine dark nodules (iron and manganese oxides); few fine light gray (10YR 7/1) weathered limestone fragments; 25 percent pebbles; slight effervescnece; mildly alkaline; clear wavy boundary.
C2—46 to 60 inches; grayish brown (10YR 5/2) gravelly loam; common medium distinct yellowish brown (10YR 5/4 and 5/6) mottles; massive; firm; common fine light gray (10YR 7/1) weathered limestone fragments; 25 percent pebbles; slight effervescence; mildly alkaline.

Solum thickness ranges from 28 to 50 inches. The mollic epipedon is 14 to 24 inches thick. In some pedons individual subhorizons of the B horizon contain free carbonates. In all pedons the C horizon contains carbonates.

The mollic epipedon has hue of 10YR, value of 3, and chroma of 1 to 3. Texture is commonly silt loam but in some pedons it is loam. Reaction ranges from slightly acid to mildly alkaline.

The B horizon below the mollic epipedon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. Texture is silt loam, loam, clay loam, or silty clay loam. Reaction is slightly acid to moderately alkaline.

The C horizon has hue of 10YR, value of 4 or 5, and chroma of 1 to 3. Texture is loam, gravelly loam, gravelly silty clay loam, gravelly sandy loam, clay loam, or silt loam. In some pedons stratified sand and gravel is below 40 inches. Reaction is mildly alkaline or moderately alkaline.

Miamian series

The Miamian series consists of well drained soils commonly on the upland adjacent to stream terraces or on end moraines. These soils formed in glacial till. Permeability is moderately slow. The slope range is 2 to 50 percent.

Miamian soils are similar to Celina, Kendallville, and Lewisburg soils and are near Crosby, Eldean, Kendallville, and Lewisburg. Crosby soils are somewhat poorly drained, and Celina soils are moderately well drained. Eldean soils are underlain by sand and gravel. Lewisburg soils have a thinner solum than Miamian soils. Kendallville soils, which formed in glacial outwash over glacial till, have less clay in the subsoil.

Typical pedon of Miamian silt loam, 6 to 12 percent slopes, eroded, Oak Run Township, 4.5 miles southeast of London, 0.3 mile north of the intersection of Spring Valley Road and Big Plain-Circleville Road along Spring Valley Road, then 165 yards east:

Ap—0 to 8 inches; brown (10YR 4/3) silt loam; moderate medium granular structure; friable; common roots; about 15 percent dark yellowish brown (10YR 4/4) material from the B horizon; few pebbles; neutral; abrupt smooth boundary.

B1—8 to 13 inches; 60 percent yellowish brown (10YR 5/4) and 40 percent brown (10YR 4/3) clay loam; weak medium subangular blocky structure; friable; common roots; very patchy brown (10YR 4/3) silt coatings on horizontal and vertical faces of peds; few pebbles; neutral; clear wavy boundary.

B21t—13 to 17 inches; yellowish brown (10YR 5/4) clay loam; moderate medium subangular blocky structure; firm; few roots; patchy yellowish brown (10YR 5/4) clay films on vertical faces of peds and very patchy yellowish brown (10YR 5/4) clay films on horizontal faces of peds; few pebbles; slightly acid; clear wavy boundary.

B22t—17 to 23 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; firm; few roots; continuous dark yellowish brown (10YR 4/4) clay films on horizontal and vertical faces of peds; few pebbles; mildly alkaline; clear wavy boundary.

B3t—23 to 27 inches; dark yellowish brown (10YR 4/4) clay loam; weak medium subangular blocky structure; firm; very patchy brown (10YR 4/3) clay films on vertical faces of peds; few prominent light gray (10YR 7/1) weathered limestone fragments; 5 percent pebbles; slight effervescence; mildly alkaline; clear wavy boundary.

C1—27 to 48 inches; brown (10YR 4/3) clay loam; common medium distinct yellowish brown (10YR 5/4) mottles; massive; firm; 7 percent pebbles; strong effervescence; moderately alkaline; clear wavy boundary.

C2—48 to 60 inches; brown (10YR 4/3) loam; common medium distinct yellowish brown (10YR 5/4) mottles; massive; firm; 7 percent pebbles; strong effervescence; moderately alkaline.

Solum thickness ranges from 20 to 40 inches. Depth to carbonates ranges from 18 to 35 inches.

The A horizon has hue of 10YR, value of 4, and chroma of 2 or 3. Texture is commonly silt loam but is clay loam in eroded areas. Reaction is slightly acid or neutral.

The B horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 through 6. Texture of the B2 horizon is silty clay loam, clay loam, silty clay, and clay. Reaction ranges from strongly acid to mildly alkaline.

The C horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. Texture is commonly loam. In some pedons the upper part is clay loam. Reaction is mildly alkaline or moderately alkaline.

Odell series

The Odell series consists of somewhat poorly drained, moderately slowly permeable soils on uplands. These soils formed in glacial till. The slope range is 0 to 6 percent.

The Odell soils in Madison County do not have the increase in clay content in the subsoil that is defined in the range of the Odell series. This difference, however, does not alter the use or management of the soils.

Odell soils are commonly near Crosby, Kokomo, and Lewisburg soils. Crosby and Lewisburg soils do not have a mollic epipedon. Kokomo soils are very poorly drained.

Typical pedon of Odell silty clay loam in an area of Odell-Lewisburg complex, 0 to 2 percent slopes, Range Township, 5 miles northwest of Mt. Sterling, 1.7 miles east of the intersection of Junk Road and Yankeetown-Chenoweth Road along Junk Road, then 505 yards south:

Ap—0 to 10 inches; very dark gray (10YR 3/1) silty clay loam; dark gray (10YR 4/1) dry; moderate medium granular structure; friable; common roots; few pebbles; medium acid; abrupt smooth boundary.

A3—10 to 17 inches; black (10YR 2/1) silty clay loam; very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure; friable; few roots; few fine dark concretions (iron and manganese oxides); few pebbles; slightly acid; clear wavy boundary.

B21—17 to 22 inches; dark yellowish brown (10YR 4/4) clay loam; common fine distinct yellowish brown (10YR 5/6) and dark grayish brown (10YR 4/2) mottles; moderate medium subangular blocky structure; firm; few roots; continuous very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) coatings on vertical faces of peds; common fine dark concretions (iron and manganese oxides); 5 percent pebbles; slightly acid; gradual wavy boundary.

B22—22 to 27 inches; dark yellowish brown (10YR 4/4) clay loam; common fine distinct yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; few roots; patchy very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) coatings on vertical and horizontal faces of peds; common fine dark concretions (iron and manganese oxides); 8 percent pebbles; neutral; gradual wavy boundary.

B3—27 to 34 inches; yellowish brown (10YR 5/4) clay loam; common medium distinct dark grayish brown (10YR 4/2) and common medium faint yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; firm; common fine white weathered limestone fragments; few fine dark concretions (iron and manganese oxides); 8 percent pebbles; slight effervescence; mildly alkaline; clear wavy boundary.

C1—34 to 47 inches; yellowish brown (10YR 5/4) loam; common medium distinct grayish brown (10YR 5/2) and common medium faint yellowish brown (10YR 5/6) mottles; massive; firm; 12 percent pebbles; slight effervescence; mildly alkaline; clear wavy boundary.

C2—47 to 60 inches; yellowish brown (10YR 5/4) loam; common medium distinct grayish brown (10YR 5/2) and common medium faint yellowish brown (10YR 5/6) mottles; massive; firm; 12 percent pebbles; strong effervescence; moderately alkaline.

Solum thickness ranges from 20 to 42 inches. Thickness of the mollic epipedon ranges from 10 to 18 inches. Depth to carbonates ranges from 20 to 40 inches.

The mollic epipedon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. Texture is dominantly silty clay loam but in some pedons is silt loam. Reaction ranges from medium acid to neutral.

The B horizon below the mollic epipedon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. Texture is silty clay loam or clay loam. The B2 horizon is medium acid or slightly acid in the upper part and slightly acid to mildly alkaline in the lower part.

The C horizon has hue of 10YR, value of 4 or 5, and chroma of 4. Texture is loam or silt loam. Reaction is mildly alkaline or moderately alkaline.

Patton series

The Patton series consists of poorly drained, moderately slowly permeable soils. These soils formed in stratified slack water deposits along small drainageways and in depressions. The slope range is 0 to 2 percent.

Patton soils are commonly near Kokomo, Crosby, and Lewisburg soils, which formed in glacial till, and are similar to Sloan and Westland soils. Kokomo soils are very poorly drained and have more clay in the subsoil than the Patton soils. Crosby soils are somewhat poorly drained and have an ochric epipedon. Lewisburg soils are moderately well drained and have an ochric epipedon. Sloan and Westland soils have more sand in the subsoil. Westland soils have sand and gravel in the substratum.

Typical pedon of Patton silty clay loam, Pike Township, 12.8 miles north-northwest of London, 0.2 mile west of the intersection of Rosedale-Mechanicsburg Road and Finley-Guy Road along Rosedale-Mechanicsburg Road, then 240 yards north:

Ap—0 to 10 inches; black (10YR 2/1) silty clay loam; very dark gray (10YR 3/1) dry; moderate medium granular structure; friable; few roots; neutral; abrupt smooth boundary.

A12—10 to 14 inches; black (10YR 2/1), moist and dry, silty clay loam; few fine distinct dark grayish brown (10YR 4/2) mottles; moderate medium subangular blocky structure; firm; few roots; neutral; gradual wavy boundary.

B2g—14 to 21 inches; dark gray (10YR 4/1) silty clay loam; few fine distinct yellowish brown (10YR 5/4) and few medium distinct grayish brown (2.5Y 5/2) mottles; weak medium subangular blocky structure; firm; few roots; patchy dark gray (10YR 4/1) silt coatings on vertical and horizontal faces of peds; slight effervescence; mildly alkaline; clear wavy boundary.

B31g—21 to 25 inches; gray (10YR 5/1) silty clay loam; common medium distinct yellowish brown (10YR 5/6) and brown (7.5YR 5/2) mottles; weak medium subangular blocky structure; firm; few roots; patchy gray (10YR 5/1) silt coatings on vertical and horizontal faces of peds; slight effervescence; mildly alkaline; gradual wavy boundary.

B32g—25 to 30 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine distinct gray (10YR 5/1) and yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; firm; few roots; patchy gray (10YR 5/1) silt coatings on horizontal and vertical faces of peds; slight effervescence; mildly alkaline; gradual wavy boundary.

C1g—30 to 36 inches; gray (10YR 5/1) silt loam; common medium distinct yellowish brown (10YR 5/4 and 5/6) mottles; massive; firm; few roots; strong effervescence; moderately alkaline; gradual wavy boundary.

C2g—36 to 49 inches; gray (10YR 5/1) silt loam; common coarse distinct yellowish brown (10YR 5/4 and 5/6) mottles; massive; firm; few roots; strong effervescence; moderately alkaline; clear wavy boundary.

C3g—49 to 60 inches; dark gray (10YR 4/1) stratified silt loam and very fine sandy loam; massive; firm; strong effervescence; moderately alkaline.

Solum thickness ranges from 24 to 42 inches. Thickness of the mollic epipedon ranges from 10 to 24 inches. Free carbonates are throughout the solum in some pedons.

The mollic epipedon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. Reaction is neutral or mildly alkaline.

The B horizon below the mollic epipedon has hue of 10YR or 2.5Y or is neutral. Value is 4 or 5. Chroma is 0 to 2. Reaction is neutral or mildly alkaline.

The C horizon has hue of 10YR or 2.5Y or is neutral. Value is 4 or 5. Chroma is 0 to 2. Texture is silt loam, silty clay loam, loam, and very fine sandy loam. This

horizon is stratified. Reaction is mildly alkaline or moderately alkaline.

Ross series

The Ross series consists of well drained, moderately permeable soils on flood plains along major streams. These soils formed in recent alluvium. The slope range is 0 to 2 percent.

Ross soils are commonly near Eldean, Medway, Miamian, Sloan, and Westland soils. Eldean soils have an ochric epipedon and are underlain by sand and gravel. Medway soils are moderately well drained. Miamian soils formed in glacial till. Sloan and Westland soils are very poorly drained.

Typical pedon of Ross silt loam, occasionally flooded, Pleasant Township, 3.5 miles northwest of Mount Sterling, 1,533 yards northeast of the intersection of Junk Road and State Route 56:

Ap1—0 to 5 inches; very dark gray (10YR 3/1) silt loam; moderate fine granular structure; friable; many roots; few pebbles; neutral; abrupt smooth boundary.

Ap2—5 to 11 inches; very dark gray (10YR 3/1) silt loam; weak coarse subangular blocky structure parting to weak fine subangular blocky; friable; common roots; few pebbles; neutral; abrupt smooth boundary.

B21—11 to 21 inches; very dark gray (10YR 3/1) silt loam; moderate coarse prismatic structure parting to moderate fine subangular blocky; friable; few roots; continuous very dark gray (10YR 3/1) silt coatings on horizontal and vertical faces of peds; few pebbles; neutral; clear wavy boundary.

B22—21 to 25 inches; very dark grayish brown (10YR 3/2) silty clay loam; weak coarse prismatic structure parting to moderate fine subangular blocky; friable; few roots; patchy very dark gray (10YR 3/1) silt coatings on horizontal and vertical faces of peds; few pebbles; neutral; clear wavy boundary.

B23—25 to 33 inches; dark brown (10YR 3/3) silty clay loam; moderate coarse prismatic structure parting to moderate fine subangular blocky; firm; few roots; continuous very dark grayish brown (10YR 3/2) silt coatings on horizontal and vertical faces of peds; few pebbles; neutral; gradual wavy boundary.

B24—33 to 40 inches; brown (10YR 4/3) clay loam; moderate medium prismatic structure parting to moderate fine subangular blocky; firm; few roots; continuous dark brown (10YR 3/3) silt coatings on horizontal and vertical faces of peds; 3 percent pebbles; neutral; clear wavy boundary.

B25—40 to 44 inches; dark yellowish brown (10YR 4/4) clay loam; weak medium prismatic structure parting to weak fine subangular blocky; firm; few roots; patchy brown (10YR 4/3) silt coatings on horizontal and vertical faces of peds; 3 percent pebbles; neutral; clear wavy boundary.

C1—44 to 52 inches; dark yellowish brown (10YR 4/4) loam; massive; friable; few fine very pale brown weathered limestone fragments; 5 percent pebbles; strong effervescence; moderately alkaline; clear wavy boundary.

C2—52 to 56 inches; brown (10YR 4/3) clay loam; massive; friable; 8 percent pebbles; strong effervescence; moderately alkaline; clear wavy boundary.

C3—56 to 60 inches; yellowish brown (10YR 5/4) gravelly sandy loam; massive; very friable; 30 percent pebbles; strong effervescence; moderately alkaline.

Solum thickness ranges from 30 to 45 inches. Thickness of the mollic epipedon ranges from 24 to 40 inches.

The mollic epipedon has hue of 10YR, value of 3, and chroma of 1 to 3.

The A horizon is dominantly silt loam but is loam in some pedons. It is neutral or mildly alkaline.

The B horizon below the mollic epipedon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. Texture is commonly clay loam. Individual subhorizons may be silty clay loam or loam. Reaction is neutral or mildly alkaline in the upper part and neutral to moderately alkaline in the lower part.

The C horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. Texture is loam, clay loam, sandy loam, or gravelly sandy loam.

Sloan series

The Sloan series consists of very poorly drained, moderately or moderately slowly permeable soils on flood plains along major streams. These soils formed in recent alluvium from upland soils. The slope range is 0 to 2 percent.

Sloan soils are commonly near Eldean, Medway, Miamian, and Ross soils. Eldean, Miamian, and Ross soils are well drained. Eldean soils are underlain with sand and gravel, and Miamian soils are underlain with till. Medway soils are moderately well drained. Ross soils have a mollic epipedon more than 24 inches thick.

Typical pedon of Sloan silty clay loam, frequently flooded, Union Township, 3.6 miles east of London, 0.3 mile east of the intersection of State Route 665 and Spring Valley Road along State Route 665, then 530 yards north:

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silty clay loam; gray (10YR 5/1) dry; moderate fine granular structure; friable; common roots; few pebbles; slight effervescence; mildly alkaline; abrupt smooth boundary.

A12—9 to 16 inches; very dark gray (10YR 3/1) silty clay loam; dark gray (10YR 4/2) dry; moderate fine granular structure; friable; few roots; continuous very

dark gray (10YR 3/1) silt coatings on horizontal and vertical faces of peds; few pebbles; neutral; abrupt wavy boundary.

B21g—16 to 23 inches; very dark grayish brown (10YR 3/2) clay loam; dark gray (10YR 4/2) dry; common fine distinct brown (10YR 4/3) mottles; moderate fine and medium subangular blocky structure; firm; few roots; continuous very dark gray (10YR 3/1) silt coatings on horizontal and vertical faces of peds; few dark concretions (iron and manganese oxides); few pebbles; neutral; clear wavy boundary.

B22g—23 to 30 inches; dark grayish brown (10YR 4/2) clay loam; common medium faint dark gray (10YR 4/1) and common fine distinct dark yellowish brown (10YR 4/4) mottles; weak medium subangular blocky structure; firm; few roots; patchy dark gray (10YR 4/1) silt coatings on vertical faces of peds; few dark concretions (iron and manganese oxides); 4 percent pebbles; slight effervescence; mildly alkaline; gradual wavy boundary.

B23g—30 to 42 inches; dark gray (10YR 4/1) clay loam; common fine distinct brown (10YR 4/3) and yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; few roots; patchy dark gray (10YR 4/1) silt coatings on vertical faces of peds; few dark concretions (iron and manganese oxides); 4 percent pebbles; slight effervescence; mildly alkaline; clear wavy boundary.

C1g—42 to 52 inches; dark gray (10YR 4/1) clay loam; few fine distinct yellowish brown (10YR 5/6) mottles; massive; firm; few light gray (10YR 7/1) weathered limestone fragments; 12 percent pebbles; slight effervescence; mildly alkaline; clear wavy boundary.

C2g—52 to 60 inches; dark gray (10YR 4/1) gravelly clay loam; common medium faint dark grayish brown (10YR 4/2) and common medium distinct yellowish brown (10YR 5/6) mottles; massive; firm; common light gray (10YR 7/1) weathered limestone fragments; 20 percent pebbles; strong effervescence; moderately alkaline.

Solum thickness ranges from 30 to 50 inches. Thickness of the mollic epipedon ranges from 10 to 24 inches. Depth to carbonates ranges from 23 to 45 inches.

The mollic epipedon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. Texture is dominantly silty clay loam but is clay loam in some pedons. Reaction ranges from slightly acid to mildly alkaline.

The B horizon below the mollic epipedon has hue of 10YR, value of 4, and chroma of 1 or 2. Texture is clay loam, silty clay loam, or silt loam. Reaction is neutral or mildly alkaline.

The C horizon has hue of 10YR, value of 4 or 5, and chroma of 1 to 3. Texture is clay loam or gravelly loam, gravelly clay loam, gravelly sandy loam, and gravelly loamy sand. Reaction is mildly alkaline or moderately alkaline.

Thackery Variant

The Thackery Variant consists of moderately well drained soils on stream terraces and outwash plains. These soils formed in loamy glacial outwash. Permeability is moderate in the subsoil. It is moderately rapid or rapid in the upper part of the substratum and slow or moderately slow in the lower part. The slope range is 0 to 6 percent.

Thackery Variant soils are similar to Celina and Kendallville soils and are commonly near Eldean and Westland soils. Celina soils have a fine textured control section and have till in the substratum. Eldean soils have a fine textured control section and are well drained. Kendallville soils are well drained and have till in the substratum. Westland soils are very poorly drained.

Typical pedon of Thackery Variant silt loam, 0 to 2 percent slopes, Paint Township, 5.8 miles south-southwest of London, 1.7 miles northeast of the intersection of Drury Road and Linson Road along Drury Road, then 395 yards west:

Ap—0 to 11 inches; dark grayish (10YR 4/2) silt loam; weak medium granular structure; friable; few roots; few pebbles; neutral; abrupt smooth boundary.

B1—11 to 14 inches; yellowish brown (10YR 5/4) silt loam; common fine faint yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; few roots; patchy brown (10YR 4/3) silt coatings on horizontal and vertical faces of peds; few pebbles; neutral; clear wavy boundary.

B21t—14 to 18 inches; yellowish brown (10YR 5/6) clay loam; common fine faint yellowish brown (10YR 5/4) and common fine distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; few roots; brown (10YR 4/3) very patchy clay films and patchy silt coatings on horizontal and vertical faces of peds; few pebbles; neutral; gradual wavy boundary.

B22t—18 to 24 inches; yellowish brown (10YR 5/4) clay loam; common fine distinct grayish brown (10YR 5/2) and common fine faint yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; firm; few roots; brown (10YR 4/3) patchy clay films on horizontal and vertical faces of peds and patchy silt coatings on horizontal faces of peds; few fine dark brown (10YR 3/3) concretions (iron and manganese oxides); few pebbles; slightly acid; gradual wavy boundary.

B23t—24 to 30 inches; yellowish brown (10YR 5/4) clay loam; common fine distinct grayish brown (10YR 5/2) and common fine faint yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; firm; few roots; brown (10YR 4/3) patchy clay films on horizontal and vertical faces of peds and very patchy silt coatings on horizontal faces of peds; few fine dark brown (10YR 3/3) concretions (iron and manganese oxides); few pebbles; neutral; clear wavy boundary.

B31—30 to 40 inches; yellowish brown (10YR 5/4) loam; common fine distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; massive; friable; many fine very pale brown (10YR 7/3) weathered limestone fragments; 5 percent pebbles; mildly alkaline; abrupt wavy boundary.
B32—40 to 46 inches; grayish brown (10YR 5/2) silt loam; common fine faint brown (10YR 5/3) and yellowish brown (10YR 5/4) mottles; massive; friable; many fine white (10YR 8/2) weathered limestone fragments; 10 percent pebbles; slight effervescence; mildly alkaline; clear wavy boundary.
C1—46 to 52 inches; grayish brown (10YR 5/2) gravelly sandy loam; single grained; loose; 25 percent pebbles; slight effervescence; mildly alkaline; abrupt wavy boundary.
IIC2—52 to 60 inches; yellowish brown (10YR 5/4) stratified silt loam and silty clay loam; massive; firm; few pebbles; strong effervescence; moderately alkaline.

Thickness of the solum ranges from 40 to 60 inches. Depth to carbonates ranges from 32 to 55 inches.

The A horizon has hue of 10YR, value of 4, and chroma of 2 or 3. Reaction is slightly acid or neutral.

The B horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 6. Texture is silt loam, loam, or clay loam. Reaction ranges from slightly acid to mildly alkaline.

The C horizon has hue of 10YR, value of 5, and chroma of 2 to 4. Texture is gravelly loam or gravelly sandy loam in the upper part and silt loam or silty clay loam in the lower part. Reaction is mildly alkaline or moderately alkaline.

Wea series

The Wea series consists of well drained soils that are moderately permeable in the upper part and very rapidly permeable in the substratum. These soils are on stream terraces. They formed in loamy and silty material over sand and gravel outwash. The slope range is 0 to 3 percent.

Wea soils are commonly near Eldean and Sloan soils. Eldean soils are less than 40 inches thick over sand and gravel and have an ochric epipedon. Sloan soils are very poorly drained and are on flood plains.

Typical pedon of Wea silt loam, 0 to 3 percent slopes, Pleasant Township, 2.5 miles north-northwest of Mt. Sterling, 0.2 mile south of the intersection of Kiousville-Palestine Road and Woods-Opossum Run Road along Kiousville-Palestine Road, then 265 yards west:

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam; dark grayish brown (10YR 4/2) dry; moderate medium granular structure; friable; few roots; few pebbles; slightly acid; abrupt smooth boundary.
A12—7 to 14 inches; very dark grayish brown (10YR 3/2) silt loam; dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; firm; few roots; patchy very dark grayish brown (10YR 3/2) silt coatings on vertical and horizontal faces of peds; few pebbles; slightly acid; gradual wavy boundary.
IIB21t—14 to 23 inches; dark brown (7.5YR 3/2) loam; grayish brown (10YR 5/2) dry; moderate medium subangular blocky structure; firm; few roots; very patchy very dark grayish brown (10YR 3/2) clay films on vertical and horizontal faces of peds; patchy dark brown (7.5YR 3/2) silt coatings on vertical and horizontal faces of peds; few pebbles; slightly acid; gradual wavy boundary.
IIB22t—23 to 30 inches; brown (7.5YR 4/4) clay loam; moderate medium subangular blocky structure; firm; few roots; patchy very dark grayish brown (10YR 3/2) clay films on vertical and horizontal faces of peds; patchy dark brown (7.5YR 3/2) silt coatings on vertical and horizontal faces of peds; few pebbles; slightly acid; gradual wavy boundary.
IIB23t—30 to 37 inches; brown (7.5YR 4/4) sandy clay loam; weak coarse subangular blocky structure; firm; few roots; very patchy dark brown (7.5YR 3/2) clay films on vertical and horizontal faces of peds; few pebbles; slightly acid; clear wavy boundary.
IIB31—37 to 46 inches; brown (7.5YR 4/4) sandy loam; weak coarse subangular blocky structure; friable; few roots; few pebbles; slightly acid; abrupt wavy boundary.
IIIB32—46 to 50 inches; dark brown (7.5YR 3/2) gravelly loam; massive; friable; common fine light gray (10YR 7/1) weathered limestone fragments; 18 percent pebbles; slight effervescence; mildly alkaline; clear wavy boundary.
IIIC—50 to 60 inches; brown (10YR 5/3) gravelly loamy sand; single grained; loose; 25 percent pebbles; strong effervescence; moderately alkaline.

Solum thickness ranges from 40 to 60 inches. Thickness of the mollic epipedon ranges from 15 to 24 inches.

The mollic epipedon has hue of 10YR or 7.5YR, value of 3, and chroma of 1 or 2. Reaction ranges from slightly acid to mildly alkaline.

The IIB horizon below the mollic epipedon has hue of 7.5YR or 10YR, value of 3 or 4, and chroma of 2 to 4. Texture is loam or clay loam in the upper part and gravelly clay loam, sandy clay loam, clay, sandy loam, or gravelly loam in the lower part. Reaction ranges from medium acid in the upper part to moderately alkaline in the lower part.

The IIIC horizon has hue of 10YR, value of 4 or 5, and chroma of 3. Texture is gravelly loamy sand or gravelly sandy loam. Reaction is mildly alkaline or moderately alkaline.

Westland series

The Westland series consists of very poorly drained, slowly or moderately slowly permeable soils on low

stream terraces and outwash plains. These soils formed in loamy outwash. The slope range is 0 to 2 percent.

The Westland soils in Madison County do not have the increase in clay content in the subsoil that is typical of the series. This difference, however, does not alter the use or management of the soils.

Westland soils are near Kokomo, Crosby, and Odell soils on the uplands and Eldean and Thackery Variant soils on outwash terraces. Kokomo, Crosby, and Odell soils have till in the substratum. Eldean soils are well drained and have an ochric epipedon. Thackery Variant soils are moderately well drained and have an ochric epipedon.

Typical pedon of Westland silty clay loam, Somerford Township, 4.2 miles northwest of London, 0.1 mile east of the intersection of U.S. Route 40 and Roberts Mill Road along U.S. Route 40, then 90 yards south:

Ap—0 to 10 inches; very dark gray (10YR 3/1) silty clay loam; dark gray (10YR 4/1) dry; moderate medium granular structure; friable; few roots; few pebbles; neutral; abrupt smooth boundary.

B1—10 to 14 inches; very dark gray (10YR 3/1) silty clay loam; dark gray (10YR 4/1) dry; common medium distinct dark grayish brown (10YR 4/2) and brown (10YR 4/3) mottles; moderate fine subangular blocky structure; firm; few roots; patchy very dark gray (10YR 3/1) silt coatings on vertical and horizontal faces of peds; few dark concretions (iron and manganese oxides); 5 percent pebbles; neutral; abrupt wavy boundary.

B21g—14 to 18 inches; dark grayish brown (10YR 4/2) clay loam; common fine distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; firm; few roots; patchy dark gray (10YR 4/1) silt coatings on vertical and horizontal faces of peds; few dark concretions (iron and manganese oxides); 5 percent pebbles; neutral; abrupt irregular boundary.

B22g—18 to 24 inches; grayish brown (10YR 5/2) clay loam; common fine distinct yellowish brown (10YR 5/4 and 5/6) mottles; moderate medium subangular blocky structure; firm; few roots; patchy gray (10YR 5/1) silt coatings on vertical and horizontal faces of peds; few dark concretions (iron and manganese oxides); 5 percent pebbles; neutral; clear wavy boundary.

B23g—24 to 29 inches; grayish brown (10YR 5/2) clay loam; many fine distinct yellowish brown (10YR 5/4 and 5/6) mottles; moderate coarse subangular blocky structure; firm; few roots; patchy grayish brown (10YR 5/2) silt coatings on vertical and horizontal faces of peds; common white (10YR 8/2) weathered limestone fragments; 8 percent pebbles; slight effervescence; mildly alkaline; gradual wavy boundary.

B24g—29 to 35 inches; grayish brown (10YR 5/2) loam; common fine distinct yellowish brown (10YR 5/4 and 5/6) mottles; moderate coarse subangular blocky structure; firm; few roots; very patchy grayish brown (10YR 5/2) silt coatings on vertical and horizontal faces of peds; common white (10YR 8/2) weathered limestone fragments; 14 percent pebbles; strong effervescence; moderately alkaline; gradual wavy boundary.

B31g—35 to 43 inches; grayish brown (10YR 5/2) gravelly loam; many medium distinct yellowish brown (10YR 5/4 and 5/6) mottles; weak coarse subangular blocky structure; friable; 20 percent pebbles; strong effervescence; moderately alkaline; gradual wavy boundary.

IIB32g—43 to 50 inches; grayish brown (10YR 5/2) gravelly sandy loam; many medium distinct yellowish brown (10YR 5/4 and 5/6) mottles; weak coarse subangular blocky structure; friable; 20 percent pebbles; strong effervescence; moderately alkaline; gradual wavy boundary.

IIC—50 to 60 inches; brown (10YR 4/3) gravelly loamy sand; single grained; loose; 16 percent pebbles; strong effervescence; moderately alkaline.

Solum thickness ranges from 32 to 60 inches. Thickness of the mollic epipedon ranges from 10 to 24 inches.

The mollic epipedon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. Texture is commonly silty clay loam but in some pedons is silt loam or clay loam.

The B horizon below the mollic epipedon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 4. Texture is silty clay loam or clay loam in the upper part and loam or sandy loam or their gravelly analogs in the lower part. Reaction ranges from neutral to moderately alkaline.

The C horizon has hue of 10YR or is neutral. Value is 2 to 7. Chroma is 0 to 3. Texture is typically sandy loam, loamy sand, gravelly loamy sand, or gravelly sand but in some pedons ranges to stratified very fine sandy loam and silty clay loam. Reaction is mildly alkaline or moderately alkaline.

formation of the soils

Soil is a three-dimensional natural body that is capable of supporting plant life. It forms through the interaction of the five factors of soil formation—parent material, climate, biological organisms, relief, and time. The type and the intensity of each factor determine the kind of soil that forms.

parent material

The unconsolidated material in which a soil forms is called parent material. It is what the other four factors act upon to produce a soil. There are several kinds of parent material in Madison County. All are derived, either directly or indirectly, from glacial drift of Wisconsin age glaciation.

Glacial till, the parent material of most of the soils in the county, is unconsolidated material of various particle sizes that was deposited directly by glacial ice. This material, mostly of local origin, is clay, silt, sand, gravel, and boulders. Particles have no common orientation and have sharp angles. The mineral makeup of the till is similar to that of the buried local limestone bedrock. Kokomo, Crosby, and Miamian soils, for example, formed in glacial till.

The parent material of other soils in the county is glacial outwash laid down by glacial melt water. As melt water increases in speed and volume, it picks up and carries larger components of till. As the melt water recedes, its volume and speed decrease and the larger material settles to the bottom. As the speed and volume further decrease, smaller particles settle. The process of deposition in layers is called stratification. The material is usually gravel. Progressively finer gravel and sand are at the top. Eldean soils formed in glacial outwash.

In some areas, a thin layer of glacial outwash was deposited over glacial till. The outwash and part of the till have weathered to form Kendallville soils.

Another parent material in Madison County is lacustrine deposits. In some areas melt water moves at a very slow speed because relief is low or the path of the water is blocked by glacial ice. The slow moving water carries the finer soil particles, which settle to the bottom and form stratified deposits. Patton soils formed in this parent material.

Along streams, some soils formed in recent alluvium. Alluvium differs from outwash in that it is soil material eroded from soils upstream that was deposited on flood plains downstream during flooding. The soils, which are continually being buried by fresh alluvium, have very little genetic development. They are the youngest soils in the county. Much of the alluvium in the county has a high organic matter content. Medway, Ross, and Sloan soils, for example, formed in alluvium.

Another kind of parent material in Madison County is organic material. This material is from plants and other living organisms that have died. The material has accumulated in depressions that are very wet. Some are ponded all year. The continuous presence of water creates an anaerobic condition (absence of oxygen) and prevents the oxidation or full decay of the organic material. Carlisle soils formed in this parent material.

time

All soils in Madison County derived from glacial till are of Wisconsin age and are less than 20,000 years old. They have highly developed genetic layers, such as a characteristic increase of clay within a specified depth. Such soils are Miamian, Crosby, and Lewisburg.

The youngest soils in the county, Ross and Sloan soils, formed in recent alluvium on flood plains. The upper part of these soils is less than 200 years old because fresh alluvium is deposited during each flood.

plants and animals

The plants and animals in an area have a profound influence on the formation of the soils. They influence color and organic matter content. Generally, soils that formed under hardwood forests are lighter in color and contain less organic matter than soils that formed under grasses. Grasses are more efficient in returning organic matter to the soil. Each year many fine roots of grasses die and quickly decay, increasing the organic matter content and darkening the color of the surface layer. Soils with higher organic matter content are generally more fertile. The large amount of organic matter and number of fine roots also produce good soil structure. Trees, on the other hand, take many years to decay. The leaves of trees supply only a small amount of organic matter compared with the leaves and roots of grasses.

Living organisms other than plants also play a vital role in the formation of soils. Large animals help recycle nutrients. Burrowing animals physically mix the soil. Earthworms mix leaf litter into the soil. Earth-boring insects and earthworms increase the porosity of the soil,

increasing aeration and the infiltration of water. Bacteria and fungi break down accumulated organic matter in the soil. These microscopic organisms are highly important. They recycle essential chemical soil components from litter into a form usable by plants and other soil organisms.

Man has considerable influence on the formation of soils. Agriculture and changes in land use have the greatest effect. Fall plowing and intensively farming steep terrain, for example, result in excessive erosion. Erosion occurs faster than soil forms and gradually exposes unweathered parent material. Man adds soil amendments and thus alters the chemical makeup of the soil. He covers the surface of many soils with buildings, roads, parking lots, and other impermeable layers. Water runs off these impermeable surfaces and floods areas that normally would not be subject to flooding.

relief

Relief is partly responsible for the formation of different soils from the same kind of parent material. A set of soils that differ in drainage primarily because of relief is called a toposequence. Miamian, Celina, Crosby, and Kokomo soils form the dominant toposequence in Madison County. The well drained Miamian soils and the moderately well drained Celina soils are on knolls and on side slopes in dissected areas. The somewhat poorly drained Crosby soils occur in the lower, less sloping areas. The very poorly drained Kokomo soils are in nearly level areas where water remains for long periods. Kokomo and Crosby soils are the dominant soils because the county is one of low relief.

climate

Climate, as a factor in soil formation, is essentially constant in Madison County. It is humid and temperate. It favors natural growth of hardwood trees. None of the differences in soils can be attributed to differences in climate. More information on the climate in Madison County is given in the section "General nature of the survey area."

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glossary

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	More than 12

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. Mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves all or part of the crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping (or contour farming). Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deferred grazing. Postponing grazing or arresting grazing for a prescribed period.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fine textured soil. Sandy clay, silty clay, and clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial melt water.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Leaching. The removal of soluble material from soil or other material by percolating water.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Muck. Dark colored, finely divided, well decomposed organic soil material.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by glacial melt water.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, differences in slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Ponding. Standing water on soils in closed depressions. The water can be removed only by percolation or evapotranspiration.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 mm in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	Less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A1, A2, or A3) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A horizon. Includes all subhorizons of this horizon (A1, A2, and A3).

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it can soak into the soil or flow slowly to a prepared outlet without harm. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive flat to undulating area underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley train. The filling of sand, gravel, and other material deposited in a valley by drainage from glaciers.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1951-75 at Columbus, Ohio]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days[1]	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	36.3	20.4	28.4	64	-7	0	2.68	1.44	3.69	7	6.9
February---	39.2	22.4	30.8	66	-4	0	2.31	1.33	3.10	7	6.1
March------	49.0	30.2	39.6	78	7	28	3.32	1.78	4.57	8	5.5
April------	62.4	40.6	51.5	84	22	114	3.53	2.17	4.74	8	.8
May--------	72.8	50.2	61.5	91	31	370	3.94	2.68	5.09	9	.0
June-------	81.9	59.1	70.5	96	43	615	3.95	2.15	5.40	7	.0
July-------	85.0	63.0	74.0	97	48	744	3.93	2.40	5.29	7	.0
August-----	83.9	61.4	72.7	97	45	704	3.24	1.80	4.40	7	.0
September--	77.3	54.3	65.8	94	34	474	2.68	1.38	3.73	6	.0
October----	66.1	43.2	54.6	86	24	182	1.03	.80	2.66	5	.1
November---	51.1	33.6	62.3	75	12	11	2.70	1.48	3.68	7	2.6
December---	39.7	24.0	32.3	68	-2	12	2.60	1.65	3.54	7	6.0
Yearly:											
Average--	62.1	41.9	32.0	---	---	---	---	---	---	---	---
Extreme--	---	---	---	98	-10	---	---	---	---	---	---
Total----	---	---	---	---	---	3,254	36.71	32.29	40.97	85	28.0

[1]A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1951-75 at Columbus, Ohio]

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 12	April 25	May 10
2 years in 10 later than--	April 7	April 20	May 5
5 years in 10 later than--	March 31	April 10	April 26
First freezing temperature in fall:			
1 year in 10 earlier than--	October 20	October 18	September 29
2 years in 10 earlier than--	October 26	October 21	October 5
5 years in 10 earlier than--	November 6	October 29	October 16

TABLE 3.--GROWING SEASON

[Recorded in the period 1951-75 at Columbus, Ohio]

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	199	181	149
8 years in 10	206	188	157
5 years in 10	219	201	172
2 years in 10	233	214	187
1 year in 10	240	221	195

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
Ca	Carlisle muck	160	0.1
CrA	Crosby silt loam, 0 to 2 percent slopes	3,817	1.3
CrB	Crosby silt loam, 2 to 6 percent slopes	402	0.1
CsA	Crosby-Lewisburg silt loams, 0 to 2 percent slopes	48,620	16.4
CsB	Crosby-Lewisburg silt loams, 2 to 6 percent slopes	77,676	26.2
ElA	Eldean silt loam, 0 to 2 percent slopes	697	0.2
ElB	Eldean silt loam, 2 to 6 percent slopes	3,864	1.3
ElC2	Eldean silt loam, 6 to 12 percent slopes, eroded	436	0.1
KeB	Kendallville silt loam, 2 to 6 percent slopes	948	0.3
KeC2	Kendallville silt loam, 6 to 12 percent slopes, eroded	188	0.1
Ko	Kokomo silty clay loam	97,467	32.9
LeB	Lewisburg-Celina silt loams, 2 to 6 percent slopes	19,555	6.6
Mk	Medway silt loam, occasionally flooded	2,612	0.9
MlB	Miamian silt loam, 2 to 6 percent slopes	3,262	1.1
MlC2	Miamian silt loam, 6 to 12 percent slopes, eroded	7,084	2.4
MlD2	Miamian silt loam, 12 to 18 percent slopes, eroded	2,831	1.0
MlE2	Miamian silt loam, 18 to 25 percent slopes, eroded	872	0.3
MlF	Miamian silt loam, 25 to 50 percent slopes	715	0.2
MnB	Miamian-Eldean silt loams, 2 to 6 percent slopes	2,364	0.8
MnC2	Miamian-Eldean silt loams, 6 to 12 percent slopes, eroded	806	0.3
OdA	Odell-Lewisburg complex, 0 to 2 percent slopes	2,226	0.8
OdB	Odell-Lewisburg complex, 2 to 6 percent slopes	557	0.2
Pa	Patton silty clay loam	1,120	0.4
Pg	Pits, gravel	340	0.1
Rs	Ross silt loam, occasionally flooded	987	0.3
So	Sloan silty clay loam, frequently flooded	6,899	2.3
ThA	Thackery Variant silt loam, 0 to 2 percent slopes	281	0.1
ThB	Thackery Variant silt loam, 2 to 6 percent slopes	207	0.1
WeA	Wea silt loam, 0 to 3 percent slopes	330	0.1
Wt	Westland silty clay loam	5,058	1.7
Wv	Westland silty clay loam, silty substratum	3,650	1.2
W	Water	289	0.1
	Total	296,320	100.0

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Corn	Soybeans	Winter wheat	Grass-legume hay
	Bu	Bu	Bu	Ton
CrA------------------------ Crosby	120	40	48	5.0
CrB------------------------ Crosby	115	38	48	5.0
CsA------------------------ Crosby-Lewisburg	115	38	45	4.8
CsB------------------------ Crosby-Lewisburg	110	35	45	4.8
ElA------------------------ Eldean	110	35	45	4.5
ElB------------------------ Eldean	100	33	45	4.0
ElC2----------------------- Eldean	85	28	40	3.0
KeB------------------------ Kendallville	110	35	45	5.0
KeC2----------------------- Kendallville	95	30	40	4.0
Ko------------------------- Kokomo	140	45	50	5.0
LeB------------------------ Lewisburg-Celina	105	33	45	4.5
Mk------------------------- Medway	140	50	---	5.0
MlB------------------------ Miamian	110	35	50	5.0
MlC2----------------------- Miamian	95	30	45	4.0
MlD2----------------------- Miamian	85	28	40	3.5
MnB------------------------ Miamian-Eldean	105	33	48	4.5
MnC2----------------------- Miamian-Eldean	90	28	43	3.5
OdA------------------------ Odell-Lewisburg	135	45	50	5.0
OdB------------------------ Odell-Lewisburg	130	43	48	5.0
Pa------------------------- Patton	130	45	50	5.0
Rs------------------------- Ross	140	50	---	5.0
So------------------------- Sloan	105	40	---	3.5

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Winter wheat	Grass-legume hay
	Bu	Bu	Bu	Ton
ThA: Thackery Variant	115	38	45	4.5
ThB: Thackery Variant	110	35	45	4.5
WeA: Wea	130	43	48	5.0
Wt: Westland	140	45	50	5.0
Wv: Westland	135	45	50	5.0

TABLE 6.--CAPABILITY CLASSES AND SUBCLASSES

[Miscellaneous areas are excluded. Absence of an entry indicates no acreage]

Class	Total acreage	Major management concerns (Subclass)		
		Erosion (e)	Wetness (w)	Soil problem (s)
		Acres	Acres	Acres
I	611	---	---	---
II	275,089	108,835	165,557	697
III	15,413	8,514	6,899	---
IV	2,831	2,831	---	---
V	160	---	160	---
VI	872	872	---	---
VII	715	715	---	---
VIII	---	---	---	---

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY

[Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available]

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Trees to plant
Ca----------------- Carlisle	4w	Slight	Severe	Severe	Severe	Eastern cottonwood-- White ash----------- Green ash----------- Black cherry-------- Swamp white oak----- Silver maple-------- Red maple-----------	80 --- --- --- --- --- ---	Eastern cottonwood, green ash, pin oak, black willow, swamp white oak, American sycamore, red maple.
CrA, CrB----------- Crosby	3o	Slight	Slight	Slight	Slight	White oak----------- Pin oak------------- Yellow-poplar------- Sweetgum------------ Northern red oak----	75 85 85 80 75	Eastern white pine, baldcypress, white ash, red maple, yellow-poplar, American sycamore.
CsA*, CsB*:								
Crosby------------	3o	Slight	Slight	Slight	Slight	White oak----------- Pin oak------------- Yellow-poplar------- Sweetgum------------ Northern red oak----	75 85 85 80 75	Eastern white pine, baldcypress, white ash, red maple, yellow-poplar, American sycamore.
Lewisburg---------	2o	Slight	Slight	Slight	Slight	White oak----------- Northern red oak----	75 80	Eastern white pine, yellow-poplar.
ElA, ElB, ElC2----- Eldean	2o	Slight	Slight	Slight	Slight	Northern red oak---- Black oak----------- White oak-----------	80 80 80	Eastern white pine, black walnut, yellow-poplar.
KeB, KeC2---------- Kendallville	1o	Slight	Slight	Slight	Slight	Northern red oak---- Yellow-poplar-------	87 95	Eastern white pine, black walnut, red pine, yellow-poplar.
Ko----------------- Kokomo	2w	Slight	Severe	Severe	Severe	Pin oak------------- White oak----------- Sweetgum------------ Northern red oak----	85 75 90 75	Eastern white pine, baldcypress, red maple, white ash, sweetgum.
LeB*:								
Lewisburg---------	2o	Slight	Slight	Slight	Slight	White oak----------- Northern red oak----	75 80	Eastern white pine, yellow-poplar.
Celina------------	1o	Slight	Slight	Slight	Slight	Northern red oak---- Yellow-poplar-------	90 110	Eastern white pine, black walnut, red pine, yellow-poplar.
Mk----------------- Medway	1o	Slight	Slight	Slight	Slight	Northern red oak---- Yellow-poplar------- Sugar maple--------- Eastern cottonwood--	86 96 --- ---	Eastern white pine, yellow-poplar, black walnut.
MlB, MlC2---------- Miamian	1o	Slight	Slight	Slight	Slight	Northern red oak---- Black walnut-------- White oak----------- Yellow-poplar-------	87 --- --- ---	Eastern white pine, black walnut, yellow-poplar.
MlD2, MlE2--------- Miamian	1r	Moderate	Moderate	Slight	Slight	Northern red oak---- Black walnut-------- White oak----------- Yellow-poplar-------	87 --- --- ---	Eastern white pine, black walnut, yellow-poplar.
MlF---------------- Miamian	1r	Severe	Severe	Slight	Slight	Northern red oak---- Black walnut-------- White oak----------- Yellow-poplar-------	87 --- --- ---	Eastern white pine, black walnut, yellow-poplar.

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Trees to plant
MnB*, MnC2*:								
Miamian	1o	Slight	Slight	Slight	Slight	Northern red oak Black walnut White oak Yellow-poplar	87 --- --- ---	Eastern white pine, black walnut, yellow-poplar.
Eldean	2o	Slight	Slight	Slight	Slight	Northern red oak Black oak White oak	80 80 80	Eastern white pine, black walnut, yellow-poplar.
OdA*, OdB*:								
Odell	---	---	---	---	---	---	---	Eastern white pine, white ash, red maple, yellow-poplar.
Lewisburg	2o	Slight	Slight	Slight	Slight	White oak Northern red oak	75 80	Eastern white pine, yellow-poplar.
Pa Patton	2w	Slight	Severe	Moderate	Moderate	Pin oak White oak Sweetgum Northern red oak	85 75 80 75	Eastern white pine, baldcypress, red maple, white ash, sweetgum.
Rs Ross	1o	Slight	Slight	Slight	Slight	Northern red oak Yellow-poplar Sugar maple	86 96 85	Eastern white pine, black walnut, white ash, yellow-poplar.
So Sloan	2w	Slight	Severe	Severe	Severe	Pin oak Swamp white oak Red maple	86 --- ---	Red maple, white ash, eastern cottonwood, Austrian pine, pin oak.
ThA, ThB Thackery Variant	1o	Slight	Slight	Slight	Slight	Northern red oak White oak	80 80	Eastern white pine, black walnut, yellow-poplar, white ash.
WeA Wea	---	---	---	---	---	---	---	Eastern white pine, red pine, black walnut, black locust, yellow-poplar, white ash.
Wt Westland	2w	Slight	Severe	Severe	Severe	Pin oak Sweetgum White oak	85 90 75	Eastern white pine, baldcypress, red maple, white ash, sweetgum.
Wv Westland	2w	Slight	Severe	Severe	Severe	White oak Pin oak	75 86	Red maple, white ash, sweetgum.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
Ca. Carlisle					
CrA, CrB: Crosby	Cutleaf staghorn sumac.	Blackhaw, arrowwood, cornelian cherry dogwood, rose-of-sharon, Amur honeysuckle, American cranberrybush, autumn-olive.	---	American basswood, Norway spruce, white spruce.	Eastern white pine.
CsA*, CsB*:					
Crosby	Cutleaf staghorn sumac.	Blackhaw, arrowwood, cornelian cherry dogwood, rose-of-sharon, Amur honeysuckle, American cranberrybush, autumn-olive.	---	American basswood, Norway spruce, white spruce.	Eastern white pine.
Lewisburg	Common ninebark, fragrant sumac, Pfitzer juniper.	Redosier dogwood, Amur honeysuckle, silky dogwood, forsythia, nannyberry viburnum.	Northern white-cedar, European alder, eastern redcedar, autumn-olive.	Norway spruce	Eastern white pine.
ElA, ElB, ElC2: Eldean	Common ninebark, fragrant sumac, Pfitzer juniper.	Autumn-olive, forsythia, Tatarian honeysuckle, nannyberry viburnum, winged euonymus, hawthorn.	Norway spruce, Scotch pine, red pine.	Austrian pine, eastern white pine.	---
KeB, KeC2: Kendallville	Common ninebark, fragrant sumac, Pfitzer juniper.	Winged euonymus, autumn-olive, forsythia, Tatarian honeysuckle, nannyberry viburnum, hawthorn.	Norway spruce, Scotch pine, red pine.	Eastern white pine, Austrian pine.	---
Ko: Kokomo	Gray dogwood, dwarf purple willow.	Amur honeysuckle, redosier dogwood, silky dogwood.	Northern white-cedar, tall purple willow, medium purple willow.	Green ash, Norway spruce.	Eastern cottonwood, American sycamore, pin oak.
LeB*:					
Lewisburg	Common ninebark, fragrant sumac, Pfitzer juniper.	Redosier dogwood, Amur honeysuckle, silky dogwood, forsythia, nannyberry viburnum.	Northern white-cedar, European alder, eastern redcedar, autumn-olive.	Norway spruce	Eastern white pine.

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
LeB*:					
Celina	Common ninebark, fragrant sumac, Pfitzer juniper.	Silky dogwood, Amur honeysuckle, redosier dogwood, forsythia, nannyberry viburnum.	Northern white-cedar, European alder, eastern redcedar, autumn-olive.	Norway spruce	Eastern white pine.
Mk: Medway	Common ninebark, fragrant sumac, Pfitzer juniper.	Silky dogwood, Amur honeysuckle, redosier dogwood, forsythia, nannyberry viburnum.	Northern white-cedar, European alder, eastern redcedar, autumn-olive.	Norway spruce	Eastern white pine.
MlB, MlC2, MlD2, MlE2, MlF: Miamian	Common ninebark, fragrant sumac, Pfitzer juniper.	Winged euonymus, autumn-olive, forsytnia, Tatarian honeysuckle, nannyberry viburnum.	Norway spruce, Scotch pine, red pine.	Eastern white pine, Austrian pine.	---
MnB*, MnC2*:					
Miamian	Common ninebark, fragrant sumac, Pfitzer juniper.	Winged euonymus, autumn-olive, forsythia, Tatarian honeysuckle, nannyberry viburnum.	Norway spruce, Scotch pine, red pine.	Eastern white pine, Austrian pine.	---
Eldean	Common ninebark, fragrant sumac, Pfitzer juniper.	Autumn-olive, forsythia, Tatarian honeysuckle, nannyberry viburnum, winged euonymus, hawthorn.	Norway spruce, Scotch pine, red pine.	Austrian pine, eastern white pine.	---
OdA*, OdB*:					
Odell	---	Medium purple willow, gray dogwood, silky dogwood, American cranberrybush, redosier dogwood.	Northern white-cedar, Norway spruce.	European alder, pin oak, eastern white pine.	---
Lewisburg	Common ninebark, fragrant sumac, Pfitzer juniper.	Redosier dogwood, Amur honeysuckle, silky dogwood, forsythia, nannyberry viburnum.	Northern white-cedar, European alder, eastern redcedar, autumn-olive.	Norway spruce	Eastern white pine.
Pa: Patton	Gray dogwood, redosier dogwood.	Amur maple, silky dogwood, oriental arborvitae.	Russian-olive, baldcypress.	Green ash, Norway spruce.	Eastern cottonwood, American sycamore, pin oak.
Pg*. Pits					

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
Rs----------------- Ross	Mockorange, common ninebark, fragrant sumac, Pfitzer juniper.	European burningbush, blackhaw, late lilac, Amur honeysuckle, shadblow serviceberry, American cranberrybush, autumn-olive.	Eastern hemlock---	Norway spruce-----	Honeylocust, eastern white pine.
So----------------- Sloan	---	Redosier dogwood, gray dogwood, silky dogwood.	European alder, northern white-cedar, black willow, medium purple willow.	Green ash, Norway spruce.	Eastern cottonwood, American sycamore, pin oak.
ThA, ThB---------- Thackery Variant	Common ninebark, fragrant sumac, Pfitzer juniper.	Silky dogwood, Amur honeysuckle, redosier dogwood, forsythia, nannyberry viburnum.	Northern white-cedar, European alder, eastern redcedar, autumn-olive.	Norway spruce-----	Eastern white pine.
WeA--------------- Wea	Mockorange, common ninebark, fragrant sumac, Pfitzer juniper.	European burningbush, blackhaw, late lilac, Amur honeysuckle, shadblow serviceberry, American cranberrybush, autumn-olive.	Eastern hemlock---	Norway spruce-----	Honeylocust, eastern white pine.
Wt, Wv------------ Westland	Gray dogwood, dwarf purple willow.	Amur honeysuckle, redosier dogwood, silky dogwood.	Northern white-cedar, tall purple willow, medium purple willow.	Green ash, Norway spruce.	Eastern cottonwood, American sycamore, pin oak.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Ca: Carlisle	Severe: floods, ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding, floods.	Severe: ponding, excess humus.	Severe: excess humus, ponding, floods.
CrA, CrB: Crosby	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Severe: erodes easily.	Moderate: wetness.
CsA*:					
Crosby	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Severe: erodes easily.	Moderate: wetness.
Lewisburg	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: erodes easily.	Slight.
CsB*:					
Crosby	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Severe: erodes easily.	Moderate: wetness.
Lewisburg	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Severe: erodes easily.	Slight.
ElA: Eldean	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: small stones.	Severe: erodes easily.	Moderate: droughty.
ElB: Eldean	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, small stones.	Severe: erodes easily.	Moderate: droughty.
ElC2: Eldean	Moderate: percs slowly, slope.	Moderate: percs slowly, slope.	Severe: slope.	Severe: erodes easily.	Moderate: droughty, slope.
KeB: Kendallville	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, small stones, percs slowly.	Severe: erodes easily.	Slight.
KeC2: Kendallville	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
Ko: Kokomo	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
LeB*:					
Lewisburg	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Severe: erodes easily.	Slight.
Celina	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Severe: erodes easily.	Slight.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Mk: Medway	Severe: floods, wetness.	Moderate: wetness.	Severe: wetness.	Slight	Moderate: floods.
MlB: Miamian	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: percs slowly, slope.	Severe: erodes easily.	Slight.
MlC2: Miamian	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
MlD2, MlE2: Miamian	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
MlF: Miamian	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.	Severe: slope.
MnB*:					
Miamian	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: percs slowly, slope.	Severe: erodes easily.	Slight.
Eldean	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, small stones.	Severe: erodes easily.	Moderate: droughty.
MnC2*:					
Miamian	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
Eldean	Moderate: percs slowly, slope.	Moderate: percs slowly, slope.	Severe: slope.	Severe: erodes easily.	Moderate: droughty, slope.
OdA*:					
Odell	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
Lewisburg	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: erodes easily.	Slight.
OdB*:					
Odell	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
Lewisburg	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Severe: erodes easily.	Slight.
Pa: Patton	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Pg*. Pits					
Rs: Ross	Severe: floods.	Slight	Moderate: floods.	Slight	Moderate: floods.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
So: Sloan	Severe: floods, wetness.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness, erodes easily.	Severe: wetness, floods.
ThA: Thackery Variant	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: erodes easily.	Slight.
ThB: Tnackery Variant	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Severe: erodes easily.	Slight.
WeA: Wea	Slight	Slight	Slight	Slight	Slight.
Wt, Wv: Westland	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
Ca: Carlisle	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
CrA: Crosby	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
CrB: Crosby	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
CsA*:										
Crosby	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Lewisburg	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
CsB*:										
Crosby	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Lewisburg	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
ElA: Eldean	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
ElB: Eldean	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
ElC2: Eldean	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
KeB: Kendallville	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
KeC2: Kendallville	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Ko: Kokomo	Good	Good	Fair	Poor	Poor	Good	Good	Good	Fair	Good.
LeB*:										
Lewisburg	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Celina	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Mk: Medway	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
MlB: Miamian	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
MlC2: Miamian	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
MlD2, MlE2: Miamian	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
MlF: Miamian	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife
MnB*:										
Miamian	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Eldean	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
MnC2*:										
Miamian	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Eldean	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
OdA*:										
Odell	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Lewisburg	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
OdB*:										
Odell	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Lewisburg	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Pa Patton	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good.
Pg*. Pits										
Rs Ross	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
So Sloan	Fair	Fair	Good	Fair	Fair	Good	Good	Fair	Fair	Good.
ThA Thackery Variant	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
ThB Thackery Variant	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
WeA Wea	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Wt, Wv Westland	Good	Good	Fair	Poor	Poor	Good	Good	Good	Fair	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Ca: Carlisle	Severe: excess humus, ponding.	Severe: ponding, low strength, floods.	Severe: ponding, low strength, floods.	Severe: ponding, low strength, floods.	Severe: low strength, ponding, floods.	Severe: excess humus, ponding, floods.
CrA, CrB: Crosby	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
CsA*:						
Crosby	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
Lewisburg	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, frost action.	Slight.
CsB*:						
Crosby	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
Lewisburg	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: slope, wetness.	Moderate: wetness, frost action.	Slight.
ElA: Eldean	Severe: cutbanks cave.	Moderate: shrink-swell.	Slight	Moderate: shrink-swell.	Severe: low strength.	Moderate: droughty.
ElB: Eldean	Severe: cutbanks cave.	Moderate: shrink-swell.	Slight	Moderate: shrink-swell, slope.	Severe: low strength.	Moderate: droughty.
ElC2: Eldean	Severe: cutbanks cave.	Moderate: shrink-swell, slope.	Moderate: slope.	Severe: slope.	Severe: low strength.	Moderate: droughty, slope.
KeB: Kendallville	Slight	Moderate: shrink-swell.	Slight	Moderate: shrink-swell, slope.	Moderate: frost action, shrink-swell.	Slight.
KeC2: Kendallville	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action, shrink-swell.	Moderate: slope.
Ko: Kokomo	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
LeB*:						
Lewisburg	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: slope, wetness.	Moderate: wetness, frost action.	Slight.
Celina	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell, slope.	Severe: low strength, frost action.	Slight.
Mk: Medway	Severe: wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: low strength, floods, frost action.	Moderate: floods.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
MlB: Miamian	Moderate: too clayey.	Slight	Slight	Moderate: slope.	Moderate: frost action, low strength.	Slight.
MlC2: Miamian	Moderate: too clayey, slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action, low strength.	Moderate: slope.
MlD2, MlE2, MlF: Miamian	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
MnB*:						
Miamian	Moderate: too clayey.	Slight	Slight	Moderate: slope.	Moderate: frost action, low strength.	Slight.
Eldean	Severe: cutbanks cave.	Moderate: shrink-swell.	Slight	Moderate: shrink-swell, slope.	Severe: low strength.	Moderate: droughty.
MnC2*:						
Miamian	Moderate: too clayey, slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action, low strength.	Moderate: slope.
Eldean	Severe: cutbanks cave.	Moderate: shrink-swell, slope.	Moderate: slope.	Severe: slope.	Severe: low strength.	Moderate: droughty, slope.
OdA*:						
Odell	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
Lewisburg	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, frost action.	Slight.
OdB*:						
Odell	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
Lewisburg	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: slope, wetness.	Moderate: wetness, frost action.	Slight.
Pa: Patton	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: frost action, low strength, ponding.	Severe: wetness.
Pg*. Pits						
Rs: Ross	Moderate: too clayey, wetness, floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods.
So: Sloan	Severe: wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: low strength, wetness, floods.	Severe: wetness, floods.
ThA: Thackery Variant	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Slight.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
ThB: Thackery Variant	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell, slope.	Severe: low strength, frost action.	Slight.
WeA: Wea	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
Wt: Westland	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
Wv: Westland	Severe: ponding, cutbanks cave.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ca: Carlisle	Severe: floods, ponding.	Severe: excess humus, seepage, floods.	Severe: floods, ponding, excess humus.	Severe: floods, ponding, seepage.	Poor: ponding, excess humus.
CrA, CrB: Crosby	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
CsA*:					
Crosby	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Lewisburg	Severe: percs slowly, wetness.	Slight	Moderate: wetness.	Moderate: wetness.	Fair: wetness.
CsB*:					
Crosby	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Lewisburg	Severe: percs slowly, wetness.	Moderate: slope.	Moderate: wetness.	Moderate: wetness.	Fair: wetness.
ElA, ElB: Eldean	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
ElC2: Eldean	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
KeB: Kendallville	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
KeC2: Kendallville	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Ko: Kokomo	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: hard to pack, ponding.
LeB*:					
Lewisburg	Severe: percs slowly, wetness.	Moderate: slope.	Moderate: wetness.	Moderate: wetness.	Fair: wetness.
Celina	Severe: wetness, percs slowly.	Severe: wetness.	Moderate: wetness, too clayey.	Moderate: wetness.	Fair: too clayey, small stones.
Mk: Medway	Severe: floods, wetness.	Severe: floods, wetness, seepage.	Severe: floods, seepage, wetness.	Severe: floods, wetness, seepage.	Poor: wetness.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
MlB------------------ Miamian	Severe: percs slowly.	Moderate: slope.	Slight-----------	Slight-----------	Fair: small stones.
MlC2----------------- Miamian	Severe: percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: small stones, slope.
MlD2, MlE2, MlF------ Miamian	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
MnB*:					
Miamian-------------	Severe: percs slowly.	Moderate: slope.	Slight-----------	Slight-----------	Fair: small stones.
Eldean--------------	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
MnC2*:					
Miamian-------------	Severe: percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: small stones, slope.
Eldean--------------	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
OdA*:					
Odell---------------	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Lewisburg-----------	Severe: percs slowly, wetness.	Slight-----------	Moderate: wetness.	Moderate: wetness.	Fair: wetness.
OdB*:					
Odell---------------	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Lewisburg-----------	Severe: percs slowly, wetness.	Moderate: slope.	Moderate: wetness.	Moderate: wetness.	Fair: wetness.
Pa------------------- Patton	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
Pg*. Pits					
Rs------------------- Ross	Severe: floods.	Severe: seepage, floods.	Severe: floods, seepage, wetness.	Severe: floods, seepage.	Fair: small stones.
So------------------- Sloan	Severe: floods, wetness, percs slowly.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.
ThA, ThB------------- Thackery Variant	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--*Continued*

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
WeA: Wea	Severe: poor filter.	Moderate: seepage.	Severe: seepage.	Slight	Fair: too clayey.
Wt: Westland	Severe: ponding, percs slowly.	Severe: seepage, ponding.	Severe: seepage, ponding.	Severe: ponding.	Poor: ponding.
Wv: Westland	Severe: ponding, percs slowly, poor filter.	Severe: seepage, ponding.	Severe: ponding.	Severe: seepage, ponding.	Poor: ponding.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ca: Carlisle	Poor: low strength, wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: wetness, excess humus.
CrA, CrB: Crosby	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones.
CsA*, CsB*:				
Crosby	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones.
Lewisburg	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
ElA, ElB, ElC2: Eldean	Good	Probable**	Probable**	Poor: small stones, area reclaim.
KeB, KeC2: Kendallville	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Ko: Kokomo	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
LeB*:				
Lewisburg	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
Celina	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Mk: Medway	Fair: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, area reclaim.
MlB: Miamian	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
MlC2: Miamian	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, small stones.
MlD2, MlE2: Miamian	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
MlF: Miamian	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
MnB*:				
Miamian	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Eldean	Good	Probable**	Probable**	Poor: small stones, area reclaim.

See footnotes at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
MnC2*:				
Miamian	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, small stones.
Eldean	Good	Probable**	Probable**	Poor: small stones, area reclaim.
OdA*, OdB*:				
Odell	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Lewisburg	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
Pa: Patton	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Pg*. Pits				
Rs: Ross	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim.
So: Sloan	Poor: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
ThA, ThB: Thackery Variant	Fair: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, area reclaim.
WeA: Wea	Good	Probable	Probable	Fair: small stones.
Wt: Westland	Poor: wetness.	Probable	Probable	Poor: wetness, small stones, area reclaim.
Wv: Westland	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.
** A few areas in uplands are not a probable source of sand and gravel.

TABLE 14.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Limitations for-- Aquifer-fed excavated ponds	Features affecting-- Drainage	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
Ca-----------------Carlisle	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Subsides, floods, frost action.	Wetness, soil blowing.	Wetness.
CrA----------------Crosby	Slight---------	Severe: piping, wetness.	Severe: slow refill.	Percs slowly, frost action.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, rooting depth.
CrB----------------Crosby	Moderate: slope.	Severe: piping, wetness.	Severe: slow refill.	Percs slowly, frost action, slope.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, rooting depth.
CsA*:						
Crosby------------	Slight---------	Severe: piping, wetness.	Severe: slow refill.	Percs slowly, frost action.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, rooting depth.
Lewisburg---------	Slight---------	Severe: piping.	Severe: no water.	Percs slowly---	Erodes easily, wetness.	Erodes easily, percs slowly.
CsB*:						
Crosby------------	Moderate: slope.	Severe: piping, wetness.	Severe: slow refill.	Percs slowly, frost action, slope.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, rooting depth.
Lewisburg---------	Moderate: slope.	Severe: piping.	Severe: no water.	Slope, percs slowly.	Erodes easily, wetness.	Erodes easily, percs slowly.
ElA, ElB-----------Eldean	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Erodes easily, too sandy.	Erodes easily, droughty.
ElC2---------------Eldean	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, erodes easily, too sandy.	Slope, erodes easily, droughty.
KeB----------------Kendallville	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Erodes easily	Erodes easily, rooting depth.
KeC2---------------Kendallville	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily, rooting depth.
Ko-----------------Kokomo	Slight---------	Severe: ponding.	Severe: slow refill.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Wetness, percs slowly.
LeB*:						
Lewisburg---------	Moderate: slope.	Severe: piping.	Severe: no water.	Slope, percs slowly.	Erodes easily, wetness.	Erodes easily, percs slowly.
Celina------------	Moderate: slope.	Severe: piping.	Severe: no water.	Frost action, slope.	Erodes easily, wetness.	Erodes easily, rooting depth.
Mk-----------------Medway	Severe: seepage.	Severe: piping, wetness.	Moderate: slow refill.	Frost action, floods.	Wetness---------	Wetness.
MlB----------------Miamian	Moderate: slope.	Severe: piping.	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
MlC2, MlD2, MlE2, MlF---------------Miamian	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Terraces and diversions	Grassed waterways
MnB*:						
Miamian	Moderate: slope.	Severe: piping.	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
Eldean	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Erodes easily, too sandy.	Erodes easily, droughty.
MnC2*:						
Miamian	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.
Eldean	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, erodes easily, too sandy.	Slope, erodes easily, droughty.
OdA*:						
Odell	Slight	Severe: piping, wetness.	Severe: slow refill.	Frost action	Wetness	Wetness.
Lewisburg	Slight	Severe: piping.	Severe: no water.	Percs slowly	Erodes easily, wetness.	Erodes easily, percs slowly.
OdB*:						
Odell	Slight	Severe: piping, wetness.	Severe: slow refill.	Frost action, slope.	Wetness	Wetness.
Lewisburg	Moderate: slope.	Severe: piping.	Severe: no water.	Slope, percs slowly.	Erodes easily, wetness.	Erodes easily, percs slowly.
Pa Patton	Moderate: seepage.	Severe: ponding.	Severe: slow refill.	Frost action, ponding.	Ponding	Wetness.
Pg*. Pits						
Rs Ross	Severe: seepage.	Severe: seepage, piping.	Moderate: deep to water, slow refill.	Deep to water	Favorable	Favorable.
So Sloan	Moderate: seepage.	Severe: piping, wetness.	Severe: slow refill.	Floods, frost action.	Erodes easily, wetness.	Wetness, erodes easily.
ThA Thackery Variant	Moderate: seepage.	Severe: piping.	Severe: slow refill.	Frost action	Erodes easily, wetness.	Erodes easily.
ThB Thackery Variant	Moderate: seepage, slope.	Severe: piping.	Severe: slow refill.	Frost action, slope.	Erodes easily, wetness.	Erodes easily.
WeA Wea	Moderate: seepage.	Moderate: thin layer.	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
Wt Westland	Moderate: seepage.	Severe: ponding.	Severe: slow refill, cutbanks cave.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Wetness, percs slowly.
Wv Westland	Severe: seepage.	Severe: ponding.	Severe: slow refill, cutbanks cave.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Wetness, percs slowly.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Ca--------------- Carlisle	0-54	Sapric material	Pt	A-8	---	---	---	---	---	---	---
	54-60	Coprogenous earth.	---	---	---	---	---	---	---	---	---
CrA, CrB--------- Crosby	0-10	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	95-100	80-100	50-90	22-34	6-15
	10-31	Clay loam, silty clay loam.	CL, CH	A-6, A-7	0-3	92-99	89-97	78-93	64-76	37-55	17-31
	31-60	Loam, clay loam, sandy loam.	CL, ML, CL-ML	A-4, A-6	0-3	88-94	83-89	74-87	50-64	17-30	2-14
CsA*, CsB*: Crosby-----------	0-10	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	95-100	80-100	50-90	22-34	6-15
	10-31	Clay loam, silty clay loam.	CL, CH	A-6, A-7	0-3	92-99	89-97	78-93	64-76	37-55	17-31
	31-60	Loam, clay loam, sandy loam.	CL, ML, CL-ML	A-4, A-6	0-3	88-94	83-89	74-87	50-64	17-30	2-14
Lewisburg--------	0-9	Silt loam--------	ML, CL-ML, CL	A-4, A-6	0-2	95-100	90-100	85-100	75-90	24-40	4-14
	9-21	Clay loam, clay, silty clay loam.	CL	A-6, A-7	0-2	90-100	85-100	80-100	65-90	32-48	14-30
	21-60	Loam, silt loam	CL, ML, CL-ML	A-6, A-4	0-5	85-100	80-95	65-90	50-75	20-35	3-13
ElA, ElB, ElC2--- Eldean	0-10	Silt loam--------	ML, CL-ML, CL	A-4, A-6	0	85-100	80-100	70-100	55-90	20-40	4-14
	10-28	Clay, clay loam, loam.	CL, ML	A-7, A-6	0-5	75-100	60-100	55-95	50-80	38-50	12-23
	28-36	Gravelly clay loam, loam, gravelly loam.	CL, GC, SC	A-4, A-6, A-7, A-2	0-10	55-85	45-85	45-75	30-60	30-45	8-20
	36-60	Stratified sand to gravel.	GM, SM, GP-GM, SP-SM	A-1, A-2	0-15	30-70	20-50	5-40	0-35	---	NP
KeB, KeC2-------- Kendallville	0-8	Silt loam--------	ML	A-4, A-6	0-2	90-100	85-100	80-95	70-90	26-40	4-12
	8-36	Clay loam, gravelly loam, sandy clay loam.	CL, SC, GC, CL-ML	A-4, A-6	0-5	70-90	55-85	50-70	45-65	25-40	6-15
	36-60	Loam, clay loam	CL, CL-ML, ML	A-4, A-6	0-3	90-100	80-95	60-80	55-70	20-35	3-14
Ko--------------- Kokomo	0-10	Silty clay loam	CL, CH	A-6, A-7	0	100	98-100	85-95	75-85	35-55	15-30
	10-32	Silty clay loam, clay loam.	CL, CH	A-6, A-7	0-1	98-100	95-100	95-100	75-95	35-55	15-30
	32-60	Loam, clay loam	CL	A-6	0-3	90-100	85-95	75-90	55-70	25-35	10-20
LeB*: Lewisburg--------	0-8	Silt loam--------	ML, CL-ML, CL	A-4, A-6	0-2	95-100	90-100	85-100	75-90	24-40	4-14
	8-22	Clay loam, clay, silty clay loam.	CL	A-6, A-7	0-2	90-100	85-100	80-100	65-90	32-48	14-30
	22-60	Loam, silt loam	CL, ML, CL-ML	A-6, A-4	0-5	85-100	80-95	65-90	50-75	20-35	3-13
Celina-----------	0-9	Silt loam--------	ML	A-4	0	100	90-100	90-100	70-85	26-40	3-10
	9-26	Clay, clay loam, silty clay loam.	CL	A-6, A-7	0	100	90-100	80-95	70-85	32-48	12-28
	26-60	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6	0	75-95	75-90	65-90	50-80	20-36	4-16

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag-ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct					Pct	
Mk: Medway	0-15	Silt loam	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	70-80	20-40	3-15
	15-34	Loam, silt loam, clay loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	95-100	80-95	75-90	70-90	20-48	4-20
	34-60	Loam, sandy loam, gravelly loam.	ML, CL, SM, SC	A-4, A-2	0	80-95	70-90	40-70	30-60	15-30	NP-10
MlB, MlC2, MlD2, MlE2, MlF: Miamian	0-8	Silt loam	ML	A-4, A-6	0	95-100	95-100	90-100	70-95	26-40	4-12
	8-27	Silty clay loam, clay loam, clay.	CL	A-6, A-7	0-5	85-100	80-100	75-95	70-85	32-50	15-30
	27-60	Loam, silt loam, clay loam.	CL, ML, CL-ML	A-4, A-6	0-5	75-95	75-90	65-85	50-75	20-35	3-13
MnB*, MnC2*: Miamian	0-9	Silt loam	ML	A-4, A-6	0	95-100	95-100	90-100	70-95	26-40	4-12
	9-31	Silty clay loam, clay loam, clay.	CL	A-6, A-7	0-5	85-100	80-100	75-95	70-85	32-50	15-30
	31-60	Loam, silt loam, clay loam.	CL, ML, CL-ML	A-4, A-6	0-5	75-95	75-90	65-85	50-75	20-35	3-13
Eldean	0-10	Silt loam	ML, CL-ML, CL	A-4, A-6	0	85-100	80-100	70-100	55-90	20-40	4-14
	10-30	Clay, sandy clay, clay loam.	CL, ML	A-7, A-6	0-5	75-100	60-100	55-95	50-80	38-50	12-23
	30-36	Gravelly clay loam, loam, gravelly loam.	CL, GC, SC	A-4, A-6, A-7, A-2	0-10	55-85	45-85	45-75	30-60	30-45	8-20
	36-60	Stratified sand to gravel.	GM, SM, GP-GM, SP-SM	A-1, A-2	0-15	30-70	20-50	5-40	0-35	---	NP
OdA*, OdB*: Odell	0-17	Silty clay loam	ML, CL	A-7, A-6	0	100	100	95-100	80-95	35-48	10-22
	17-34	Silty clay loam, clay loam.	CL	A-7, A-6	0	90-100	85-95	80-90	70-80	35-50	17-28
	34-60	Loam, silt loam	CL, CL-ML, ML	A-4, A-6	0-3	85-95	80-90	75-85	55-65	20-38	2-16
Lewisburg	0-8	Silt loam	ML, CL-ML, CL	A-4, A-6	0-2	95-100	90-100	85-100	75-90	24-40	4-14
	8-22	Clay loam, clay, silty clay loam.	CL	A-6, A-7	0-2	90-100	85-100	80-100	65-90	32-48	14-30
	22-60	Loam, silt loam	CL, ML, CL-ML	A-6, A-4	0-5	85-100	80-95	65-90	50-75	20-35	3-13
Pa: Patton	0-14	Silty clay loam	CL	A-6	0	100	100	95-100	75-95	30-40	10-20
	14-30	Silty clay loam	CL, CH, ML, MH	A-7	0	100	100	95-100	80-100	40-55	15-25
	30-60	Stratified very fine sandy loam to silty clay loam.	CL	A-6	0	100	100	95-100	75-95	25-40	10-20
Pg*. Pits											
Rs: Ross	0-21	Silt loam	ML, CL-ML, CL	A-4, A-6	0	90-100	90-100	80-100	65-95	20-35	NP-12
	21-56	Clay loam, loam, silty clay loam.	ML, CL, CL-ML	A-6, A-4, A-7	0	90-100	85-100	70-100	55-95	22-45	3-20
	56-60	Stratified gravelly sandy loam to silt loam.	CL, ML, SM, GM	A-6, A-1, A-2, A-4	0-5	65-100	55-100	35-100	20-80	<30	NP-12

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
So---------------- Sloan	0-16	Silty clay loam	CL	A-6, A-7	0	100	95-100	85-100	70-95	35-45	12-20
	16-42	Silty clay loam, clay loam, silt loam.	CL, ML	A-6, A-7, A-4	0	100	90-100	85-100	75-95	30-45	8-18
	42-60	Stratified gravelly sandy loam to silty clay loam.	ML, CL	A-4, A-6	0	95-100	70-100	60-95	50-90	25-40	3-15
ThA, ThB--------- Thackery Variant	0-11	Silt loam--------	ML, CL-ML, CL	A-4, A-6	0	95-100	90-100	80-100	65-90	22-36	3-14
	11-30	Silt loam, clay loam.	CL, CL-ML, ML	A-6, A-7, A-4	0-2	95-100	90-100	80-100	60-90	20-42	3-20
	30-46	Loam, silt loam	CL	A-6	0-5	90-100	85-100	75-100	45-90	25-40	10-20
	46-52	Gravelly sandy loam.	SM, SC, SM-SC, SP-SM	A-1, A-2	0-5	65-90	45-75	25-50	10-30	<25	NP-10
	52-60	Stratified silt loam to silty clay loam.	CL-ML, CL, ML	A-4, A-6, A-7	0	100	90-100	80-100	65-95	20-42	3-20
WeA-------------- Wea	0-14	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-90	25-35	5-15
	14-37	Sandy clay loam, clay loam, loam.	CL	A-6, A-7	0	95-100	90-95	85-95	65-90	35-50	15-30
	37-50	Gravelly loam, sandy loam.	CL, SM-SC, SC, CL-ML	A-4, A-6	0-5	70-85	65-85	60-80	35-65	15-30	5-15
	50-60	Stratified sand to gravelly loamy sand.	SP, SP-SM, GP, GP-GM	A-1	1-5	30-70	20-55	5-20	0-10	---	NP
Wt--------------- Westland	0-14	Silty clay loam	CL	A-6, A-7	0	100	95-100	90-100	75-90	30-45	10-25
	14-35	Clay loam, loam	CL	A-6, A-7	0	95-100	90-100	80-90	65-75	35-50	15-30
	35-50	Gravelly loam, gravelly sandy loam.	CL	A-6, A-7	0-5	65-75	60-70	55-70	50-70	30-50	15-30
	50-60	Stratified sand to gravelly loamy sand.	SP, GP, SP-SM, GP-GM	A-1	1-5	30-70	22-55	7-20	2-10	---	NP
Wv--------------- Westland	0-9	Silty clay loam	CL	A-6, A-7	0	100	95-100	90-100	75-90	30-45	12-25
	9-26	Clay loam, silty clay loam.	CL	A-6, A-7	0	95-100	90-100	80-95	65-75	30-45	12-25
	26-34	Gravelly sandy loam, gravelly loamy sand.	SM, SM-SC, SP-SM	A-2, A-4, A-1	0-5	80-95	60-90	35-70	10-40	<20	NP-7
	34-44	Stratified loamy very fine sand to silty clay loam.	ML, CL-ML, CL	A-6, A-4, A-7	0	100	95-100	80-100	60-90	25-45	4-18

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH					Pct
Ca	0-54	---	0.13-0.23	0.2-6.0	0.35-0.45	4.5-7.3	-------------	----	---	3	>70
Carlisle	54-60	---	---	0.2-6.0	---	6.6-7.8	-------------	----	---		
CrA, CrB	0-10	11-22	1.40-1.55	0.6-2.0	0.20-0.24	5.1-6.5	Low	0.43	3	5	1-3
Crosby	10-31	35-45	1.50-1.70	0.06-0.2	0.15-0.20	5.1-7.3	Moderate	0.43			
	31-60	15-32	1.70-2.00	0.06-0.6	0.05-0.19	7.9-8.4	Low	0.43			
CsA*, CsB*:											
Crosby	0-10	11-22	1.40-1.55	0.6-2.0	0.20-0.24	5.1-6.5	Low	0.43	3	5	1-3
	10-31	35-45	1.50-1.70	0.06-0.2	0.15-0.20	5.1-7.3	Moderate	0.43			
	31-60	15-32	1.70-2.00	0.06-0.6	0.05-0.19	7.9-8.4	Low	0.43			
Lewisburg	0-9	16-27	1.30-1.55	0.6-2.0	0.18-0.24	5.6-7.3	Low	0.43	3	6	1-4
	9-21	35-49	1.40-1.75	0.2-2.0	0.11-0.18	5.6-7.8	Moderate	0.32			
	21-60	18-27	1.55-1.85	0.06-0.2	0.08-0.12	7.4-8.4	Low	0.32			
ElA, ElB, ElC2	0-10	15-25	1.30-1.55	0.6-2.0	0.18-0.22	5.6-7.3	Low	0.37	4	5	1-4
Eldean	10-28	35-48	1.45-1.65	0.2-2.0	0.08-0.14	5.6-7.8	Moderate	0.37			
	28-36	25-45	1.30-1.60	0.6-2.0	0.07-0.14	6.6-8.4	Low	0.37			
	36-60	2-8	---	>6.0	0.01-0.04	7.4-8.4	Low	0.10			
KeB, KeC2	0-8	8-24	1.30-1.50	0.6-2.0	0.18-0.24	5.6-7.3	Low	0.37	3	6	1-4
Kendallville	8-36	23-38	1.40-1.65	0.6-2.0	0.12-0.16	4.5-7.8	Moderate	0.37			
	36-60	12-30	1.45-1.75	0.2-0.6	0.11-0.15	7.4-8.4	Low	0.37			
Ko	0-10	27-35	1.35-1.50	0.6-2.0	0.17-0.19	6.1-7.3	Moderate	0.32	3	4	3-6
Kokomo	10-32	35-40	1.40-1.60	0.6-2.0	0.18-0.20	6.1-7.3	Moderate	0.32			
	32-60	16-25	1.50-1.75	0.2-0.6	0.05-0.19	7.4-8.4	Low	0.32			
LeB*:											
Lewisburg	0-8	16-27	1.30-1.55	0.6-2.0	0.18-0.24	5.6-7.3	Low	0.43	3	6	1-4
	8-22	35-49	1.40-1.75	0.2-2.0	0.11-0.18	5.6-7.8	Moderate	0.32			
	22-60	18-27	1.55-1.85	0.06-0.2	0.08-0.12	7.4-8.4	Low	0.32			
Celina	0-9	14-26	1.30-1.50	0.6-2.0	0.17-0.20	5.6-7.3	Low	0.37	5	6	1-4
	9-26	35-48	1.45-1.70	0.2-0.6	0.16-0.19	4.5-7.8	Moderate	0.37			
	26-60	16-27	1.50-1.80	0.2-0.6	0.06-0.10	7.4-8.4	Low	0.37			
Mk	0-15	18-27	1.20-1.45	0.6-2.0	0.17-0.22	6.1-8.4	Low	0.32	5	6	3-5
Medway	15-34	18-32	1.20-1.50	0.6-2.0	0.14-0.18	6.1-8.4	Low	0.32			
	34-60	10-25	1.20-1.60	0.6-6.0	0.08-0.15	6.6-8.4	Low	0.32			
MlB, MlC2, MlD2, MlE2, MlF	0-8	14-27	1.30-1.50	0.6-2.0	0.17-0.20	5.6-7.3	Low	0.37	5	6	1-4
Miamian	8-27	35-48	1.45-1.70	0.2-0.6	0.12-0.18	4.5-7.8	Moderate	0.37			
	27-60	16-31	1.50-1.80	0.2-0.6	0.06-0.10	7.4-8.4	Low	0.37			
MnB*, MnC2*:											
Miamian	0-9	14-27	1.30-1.50	0.6-2.0	0.17-0.20	5.6-7.3	Low	0.37	5	6	1-4
	9-31	35-48	1.45-1.70	0.2-0.6	0.12-0.18	4.5-7.8	Moderate	0.37			
	31-60	16-31	1.50-1.80	0.2-0.6	0.06-0.10	7.4-8.4	Low	0.37			
Eldean	0-10	15-25	1.30-1.55	0.6-2.0	0.18-0.22	5.6-7.3	Low	0.37	4	5	1-4
	10-30	35-48	1.45-1.65	0.2-2.0	0.08-0.14	5.6-7.8	Moderate	0.37			
	30-36	25-45	1.30-1.60	0.6-2.0	0.07-0.14	6.6-8.4	Low	0.37			
	36-60	2-8	---	>6.0	0.01-0.04	7.4-8.4	Low	0.10			
OdA*, OdB*:											
Odell	0-17	27-38	1.35-1.50	0.6-2.0	0.21-0.23	5.6-7.3	Moderate	0.28	5	7	3-5
	17-34	30-40	1.50-1.70	0.2-0.6	0.15-0.19	5.6-7.8	Moderate	0.37			
	34-60	18-30	1.50-1.70	0.2-0.6	0.08-0.12	7.4-8.4	Low	0.37			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH					Pct
OdA*, OdB*:											
Lewisburg-------	0-8	16-27	1.30-1.55	0.6-2.0	0.18-0.24	5.6-7.3	Low-----------	0.43	3	6	1-4
	8-22	35-49	1.40-1.75	0.2-2.0	0.11-0.18	5.6-7.8	Moderate------	0.32			
	22-60	18-27	1.55-1.85	0.06-0.2	0.08-0.12	7.4-8.4	Low-----------	0.32			
Pa--------------- Patton	0-14	22-27	1.15-1.35	0.6-2.0	0.21-0.23	6.6-7.3	Moderate------	0.28	5	7	3-5
	14-30	27-35	1.25-1.45	0.2-2.0	0.18-0.20	6.1-7.8	Moderate------	0.28			
	30-60	22-35	1.30-1.50	0.2-2.0	0.18-0.22	7.4-8.4	Moderate------	0.28			
Pg* Pits											
Rs--------------- Ross	0-21	15-27	1.20-1.45	0.6-2.0	0.19-0.24	6.1-7.8	Low-----------	0.24	5	5	3-5
	21-56	18-32	1.20-1.50	0.6-2.0	0.16-0.22	6.1-8.4	Low-----------	0.24			
	56-60	5-25	1.35-1.60	0.6-6.0	0.05-0.18	6.1-8.4	Low-----------	0.24			
So--------------- Sloan	0-16	27-33	1.25-1.50	0.6-2.0	0.18-0.22	6.1-7.8	Moderate------	0.37	5	6	3-6
	16-42	22-35	1.20-1.50	0.2-2.0	0.15-0.19	6.1-8.4	Moderate------	0.37			
	42-60	10-30	1.20-1.50	0.2-2.0	0.13-0.18	6.6-8.4	Low-----------	0.37			
ThA, ThB--------- Thackery Variant	0-11	15-25	1.35-1.55	0.6-2.0	0.20-0.24	6.1-7.3	Low-----------	0.37	4	5	1-4
	11-30	20-35	1.45-1.65	0.6-2.0	0.15-0.22	6.1-7.3	Moderate------	0.37			
	30-46	18-27	1.40-1.60	0.2-2.0	0.14-0.21	6.6-7.8	Low-----------	0.37			
	46-52	10-20	1.20-1.60	2.0-20	0.05-0.10	7.4-8.4	Low-----------	0.20			
	52-60	20-35	1.50-1.70	0.06-0.6	0.10-0.15	7.4-8.4	Moderate------	0.43			
WeA-------------- Wea	0-14	18-27	1.30-1.45	0.6-2.0	0.20-0.24	5.1-6.5	Low-----------	0.32	5	5	2-5
	14-37	20-35	1.40-1.60	0.6-2.0	0.15-0.20	5.1-6.5	Moderate------	0.43			
	37-50	15-25	1.35-1.50	0.6-2.0	0.10-0.12	6.1-8.4	Low-----------	0.24			
	50-60	1-7	1.50-1.75	>20	0.02-0.04	7.4-8.4	Low-----------	0.10			
Wt--------------- Westland	0-14	27-35	1.35-1.50	0.6-2.0	0.22-0.24	5.6-7.3	Moderate------	0.28	5	7	2-6
	14-35	27-35	1.45-1.60	0.2-0.6	0.15-0.19	5.6-7.3	Moderate------	0.28			
	35-50	15-30	1.40-1.60	0.2-0.6	0.14-0.16	5.6-7.3	Moderate------	0.28			
	50-60	1-7	1.50-1.75	>20	0.02-0.04	7.4-8.4	Low-----------	0.10			
Wv--------------- Westland	0-9	27-35	1.40-1.50	0.6-2.0	0.21-0.23	5.6-7.3	Moderate------	0.28	5	7	4-8
	9-26	20-35	1.45-1.60	0.2-0.6	0.15-0.19	5.6-7.8	Moderate------	0.28			
	26-34	8-20	1.40-1.55	2.0-20	0.07-0.11	7.4-8.4	Low-----------	0.10			
	34-44	10-32	1.40-1.60	0.06-0.6	0.13-0.17	7.4-8.4	Moderate------	0.37			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--SOIL AND WATER FEATURES

[See text for descriptions of symbols and such terms as "rare," "brief," "apparent," and "perched." The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
Ca**----------------- Carlisle	A/D	Frequent----	Long------	Nov-May	+.5-1.0	Apparent	Sep-Jun	>60	---	High-----	High-----	Low.
CrA, CrB---------- Crosby	C	None--------	---	---	1.0-3.0	Apparent	Jan-Apr	>60	---	High-----	High-----	Moderate.
CsA*, CsB*:												
Crosby-----------	C	None--------	---	---	1.0-3.0	Apparent	Jan-Apr	>60	---	High-----	High-----	Moderate.
Lewisburg--------	C	None--------	---	---	2.0-4.0	Perched	Jan-Apr	>60	---	Moderate	Moderate	Moderate.
ElA, ElB, ElC2---- Eldean	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Moderate.
KeB, KeC2--------- Kendallville	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
Ko**-------------- Kokomo	B/D	None--------	---	---	+5-1.0	Apparent	Dec-May	>60	---	High-----	High-----	Low.
LeB*:												
Lewisburg--------	C	None--------	---	---	2.0-4.0	Perched	Jan-Apr	>60	---	Moderate	Moderate	Moderate.
Celina-----------	C	None--------	---	---	2.0-3.5	Perched	Jan-Apr	>60	---	High-----	High-----	Moderate.
Mk---------------- Medway	B	Occasional	Very brief	Nov-Jun	1.0-2.5	Apparent	Jan-Apr	>60	---	High-----	High-----	Low.
MlB, MlC2, MlD2, MlE2, MlF-------- Miamian	C	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
MnB*, MnC2*:												
Miamian----------	C	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
Eldean-----------	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Moderate.
OdA*, OdB*:												
Odell------------	B	None--------	---	---	1.0-3.0	Apparent	Jan-Apr	>60	---	High-----	High-----	Moderate.
Lewisburg--------	C	None--------	---	---	2.0-4.0	Perched	Jan-Apr	>60	---	Moderate	Moderate	Moderate.
Pa**-------------- Patton	B/D	None--------	---	---	+.5-2.0	Apparent	Mar-Jun	>60	---	High-----	High-----	Low.
Pg*. Pits												
Rs---------------- Ross	B	Occasional	Very brief	Nov-Jun	4.0-6.0	Apparent	Feb-Apr	>60	---	Moderate	Low------	Low.

See footnotes at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hardness	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In				
So----------------- Sloan	B/D	Frequent----	Brief-----	Nov-Jun	0-1.0	Apparent	Nov-Jun	>60	---	High-----	High-----	Low.
ThA, ThB---------- Thackery Variant	B	None--------	---	---	2.0-3.5	Apparent	Jan-Apr	>60	---	High-----	Moderate	Low.
WeA--------------- Wea	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
Wt**-------------- Westland	B/D	None--------	---	---	+.5-1.0	Apparent	Dec-May	>60	---	High-----	High-----	Low.
Wv**-------------- Westland	B/D	None--------	---	---	+1-1.0	Apparent	Dec-May	>60	---	High-----	High-----	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.
** A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water is above the surface. The second numeral indicates the depth below the surface.

TABLE 18.--ENGINEERING INDEX TEST DATA

Soil name and location	Parent material	Report No.	Depth	Horizon	Moisture density[1]: Max. dry density	Moisture density[1]: Optimum moisture	Mechanical analysis[2] — Percentage passing sieve: No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)	Mechanical analysis[2]: Percentage smaller than 0.005 mm	Liquid limit	Plasticity index	Classification: AASHTO[3]	Classification: Unified[4]
			In		Pcf	Pct						Pct			
Lewisburg silt loam:															
In Pleasant Township, 3.4 miles north of Mount Sterling, 0.2 mile northwest of the intersection of Kiousville-Palestine Road and Anderson-Antioch Road along Kiousville-Palestine Road, then 310 yards west.	Glacial till.	Ma-17													
		94685	0-9	Ap	107	18	100	100	97	80	30	26	7	A-4	CL-ML
		94686	9-15	B2t	102	20	100	100	97	85	51	37	15	A-6	CL
		94687	33-55	C2&C3	129	10	87	81	71	56	20	21	6	A-4	CL-ML
Odell silty clay loam:															
In Range Township, 5 miles northwest of Mount Sterling, 1.7 miles east of the intersection of Junk Road and Yankeetown-Chenoweth Road along Junk Road, then 505 yards south.	Glacial till.	Ma-19													
		08341	0-10	Ap	95	24	100	100	98	88	39	42	11	A-7-5	ML
		08342	22-27	B22	107	18	100	91	89	79	33	46	22	A-7-6	CL
		08343	47-60	C2	129	10	94	83	76	62	23	24	7	A-4	CL-ML

[1]Based on AASHTO Designation: T 99, Method A (2).

[2]Mechanical analysis according to AASHTO Designation: T 88. Results by this procedure may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHTO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analysis data in this table are not suitable for naming textural classes for soils.

[3]Based on AASHTO Designation M 145.

[4]Based on ASTM Standard D 2487.

TABLE 19.--CLASSIFICATION OF THE SOILS

[An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series]

Soil name	Family or higher taxonomic class
Carlisle	Euic, mesic Typic Medisaprists
Celina	Fine, mixed, mesic Aquic Hapludalfs
Crosby	Fine, mixed, mesic Aeric Ochraqualfs
Eldean	Fine, mixed, mesic Typic Hapludalfs
Kendallville	Fine-loamy, mixed, mesic Typic Hapludalfs
Kokomo	Fine, mixed, mesic Typic Argiaquolls
Lewisburg	Fine, mixed, mesic Typic Hapludalfs
Medway	Fine-loamy, mixed, mesic Fluvaquentic Hapludolls
Miamian	Fine, mixed, mesic Typic Hapludalfs
*Odell	Fine-loamy, mixed, mesic Aquic Argiudolls
Patton	Fine-silty, mixed, mesic Typic Haplaquolls
Ross	Fine-loamy, mixed, mesic Cumulic Hapludolls
Sloan	Fine-loamy, mixed, mesic Fluvaquentic Haplaquolls
Thackery Variant	Fine-loamy, mixed, mesic Aquic Hapludalfs
Wea	Fine-loamy, mixed, mesic Typic Argiudolls
*Westland	Fine-loamy, mixed, mesic Typic Argiaquolls

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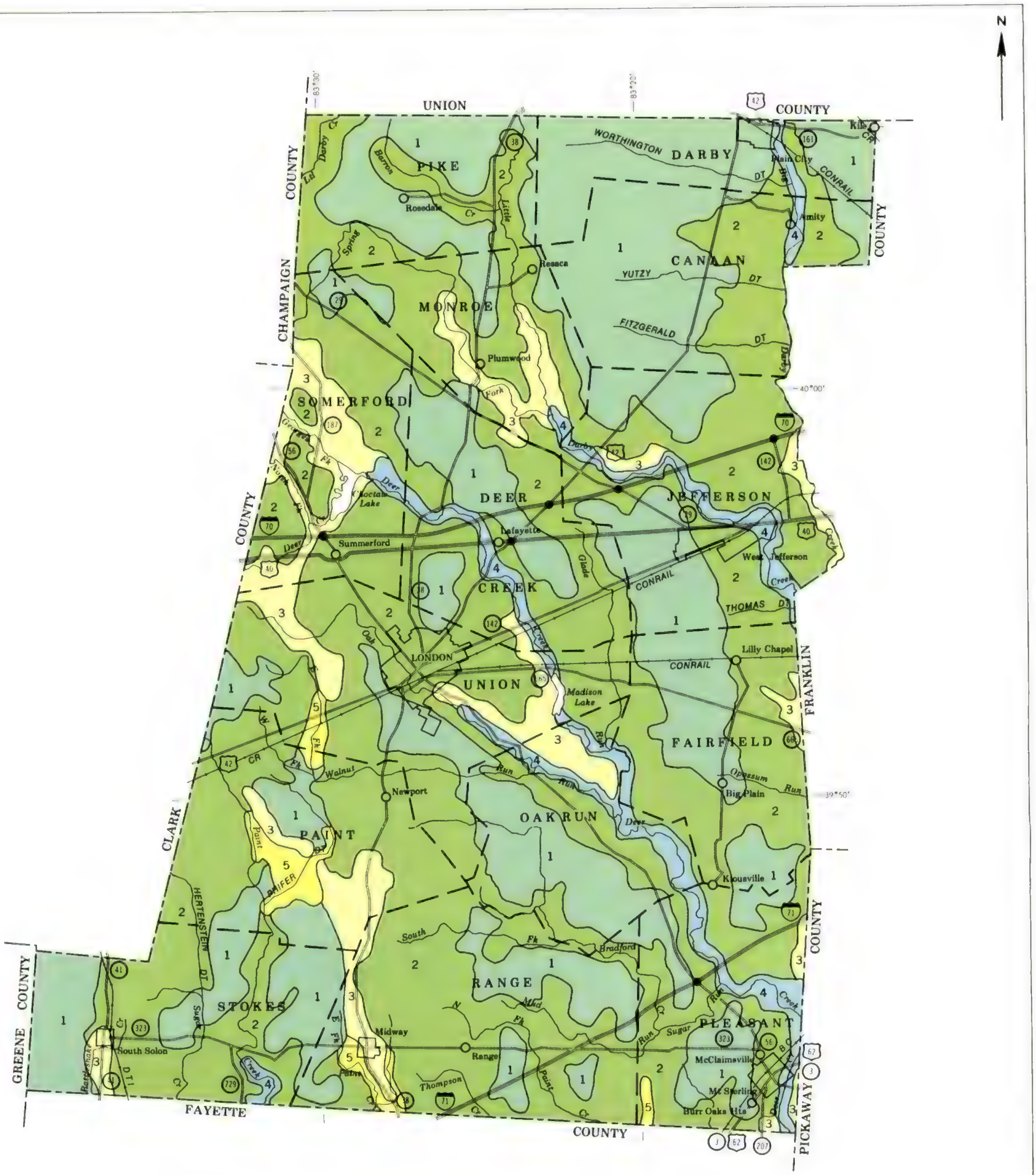


SOIL LEGEND

1	Kokomo-Crosby-Lewisburg association: Nearly level and gently sloping, very poorly drained, somewhat poorly drained, and moderately well drained soils formed in glacial till
2	Crosby-Kokomo-Lewisburg association: Nearly level and gently sloping, somewhat poorly drained, very poorly drained, and moderately well drained soils formed in glacial till
3	Lewisburg-Celina-Miamian association: Gently sloping to very steep, moderately well drained and well drained soils formed in glacial till
4	Sloan-Eldean-Medway association: Nearly level to sloping, very poorly drained, well drained, and moderately well drained soils formed in glacial outwash and alluvium
5	Westland association: Nearly level, very poorly drained soils formed in glacial outwash

Compiled 1980

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
OHIO DEPARTMENT OF NATURAL RESOURCES,
DIVISION OF LANDS AND SOIL
OHIO AGRICULTURAL RESEARCH AND DEVELOPMENT CENTER

GENERAL SOIL MAP
MADISON COUNTY, OHIO

Scale 1:190,080

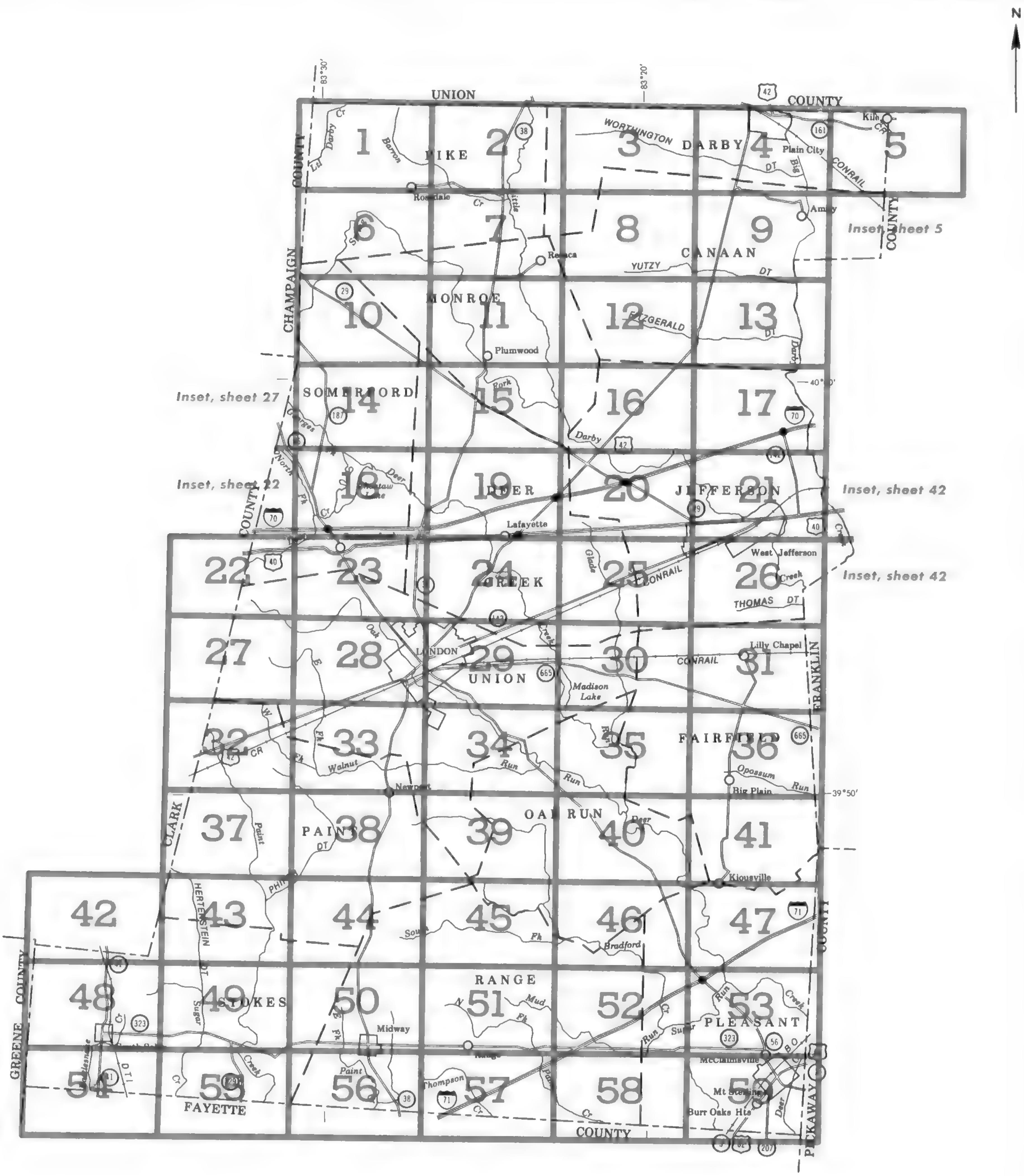
1 0 1 2 3 4 Miles

1 0 1 2 3 4 5 6 Kilometers

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36



Original text from each individual map sheet read:
This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

INDEX TO MAP SHEETS
MADISON COUNTY, OHIO

Scale 1:190,080

1 0 1 2 3 4 Miles

1 0 1 2 3 4 5 6 Kilometers

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

SOIL LEGEND

Map symbols consist of a combination of letters or of letters and numbers. The first capital letter is the initial one of the map unit name. The lowercase letter that follows separates map units having names that begin with the same letter, except that it does not separate sloping or eroded phases. The second capital letter indicates the class of slope. Symbols without a slope letter are for nearly level soils or miscellaneous areas. A final number of 2 indicates that the soil is eroded.

SYMBOL	NAME
Ca	Carlisle muck
CrA	Crosby silt loam, 0 to 2 percent slopes
CrB	Crosby silt loam, 2 to 6 percent slopes
CsA	Crosby-Lewisburg silt loams, 0 to 2 percent slopes
CsB	Crosby-Lewisburg silt loams, 2 to 6 percent slopes
ElA	Eldean silt loam, 0 to 2 percent slopes
ElB	Eldean silt loam, 2 to 6 percent slopes
ElC2	Eldean silt loam, 6 to 12 percent slopes, eroded
KeB	Kendallville silt loam, 2 to 6 percent slopes
KeC2	Kendallville silt loam, 6 to 12 percent slopes, eroded
Ko	Kokomo silty clay loam
LeB	Lewisburg-Celina silt loams, 2 to 6 percent slopes
Mx	Medway silt loam, occasionally flooded
MlB	Miamian silt loam, 2 to 6 percent slopes
MlC2	Miamian silt loam, 6 to 12 percent slopes, eroded
MlD2	Miamian silt loam, 12 to 18 percent slopes, eroded
MlE2	Miamian silt loam, 18 to 25 percent slopes, eroded
MlF	Miamian silt loam, 25 to 50 percent slopes
MnB	Miamian-Eldean silt loams, 2 to 6 percent slopes
MnC2	Miamian-Eldean silt loams, 6 to 12 percent slopes, eroded
OdA	Odell-Lewisburg complex, 0 to 2 percent slopes
OdB	Odell-Lewisburg complex, 2 to 6 percent slopes
Pa	Patton silty clay loam
Pg	Pits, gravel
Rs	Ross silt loam, occasionally flooded
So	Sloan silty clay loam, frequently flooded
ThA	Thackery Variant silt loam, 0 to 2 percent slopes
ThB	Thackery Variant silt loam, 2 to 6 percent slopes
WeA	Wea silt loam, 0 to 3 percent slopes
Wt	Westland silty clay loam
Wv	Westland silty clay loam, silty substratum

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool — Davis Airstrip; FLOOD POOL LINE

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEMS & DESIGNATIONS

- Interstate
- Federal
- State
- County, farm or ranch

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small — water

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) — Indian Mound
- Located object (label) — Tower
- Tank (label) — GAS
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double line (label) — CANAL
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial — water
- Intermittent

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS — CrA, Rs

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

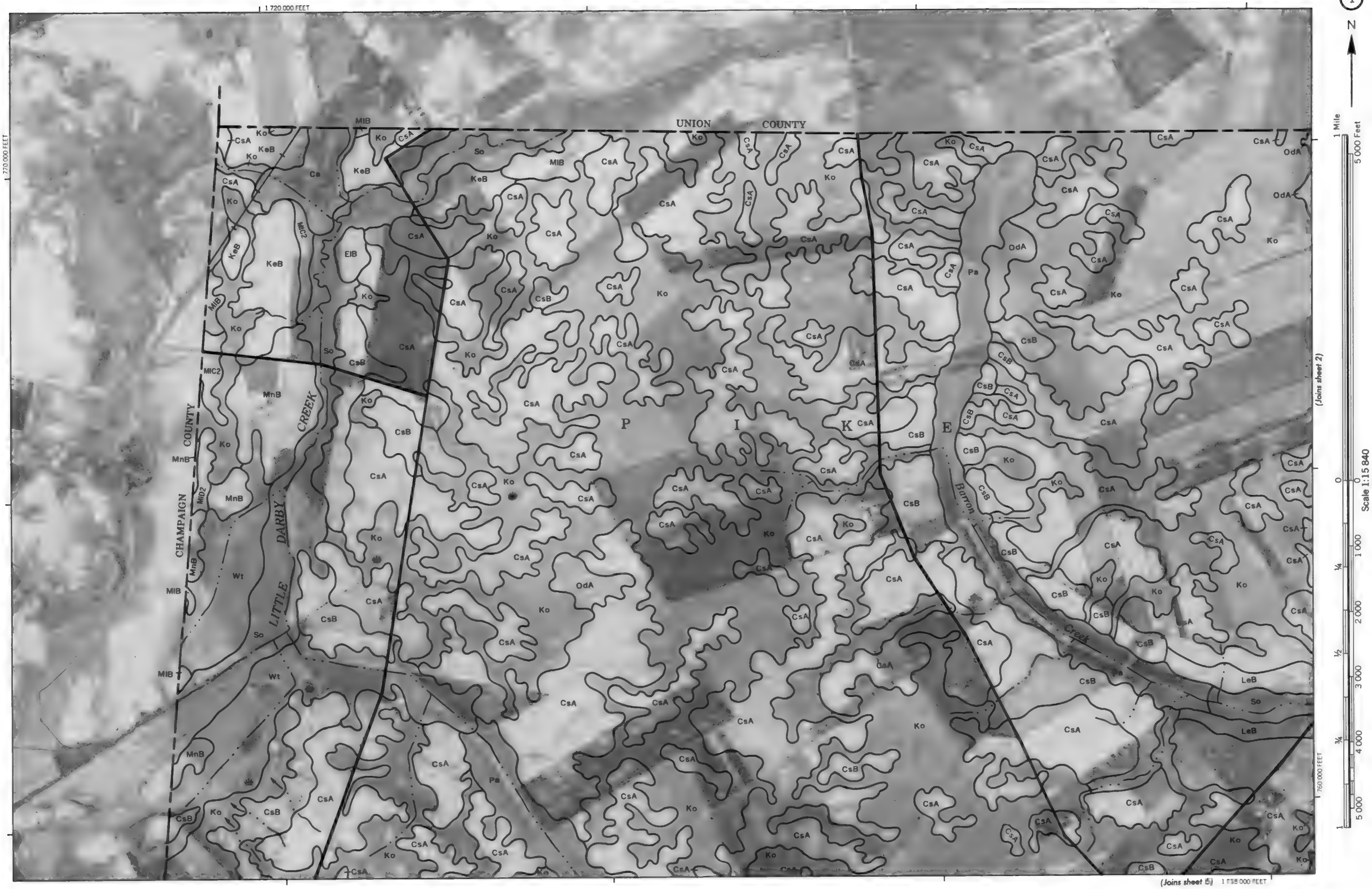
GULLY

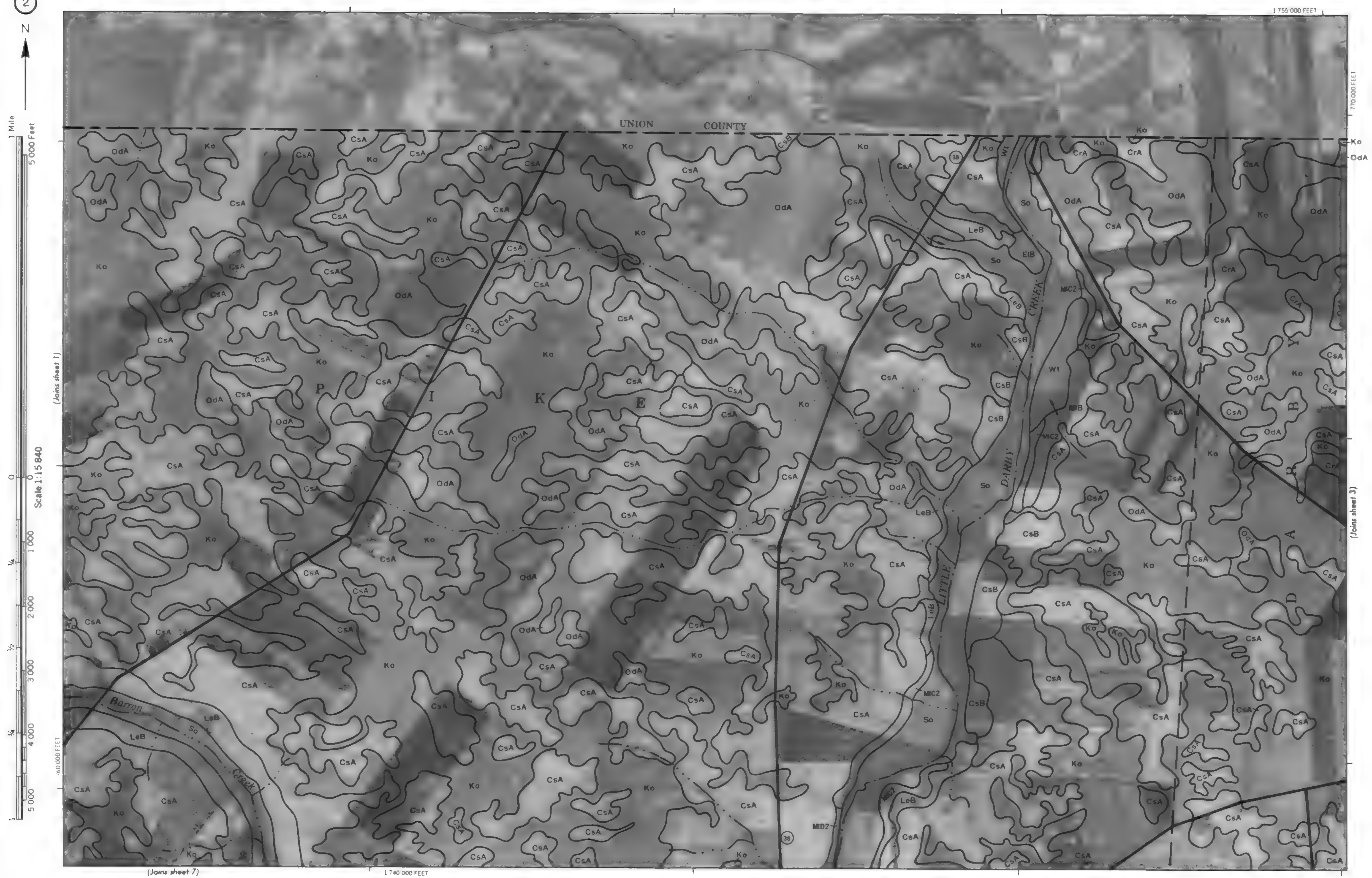
DEPRESSION OR SINK

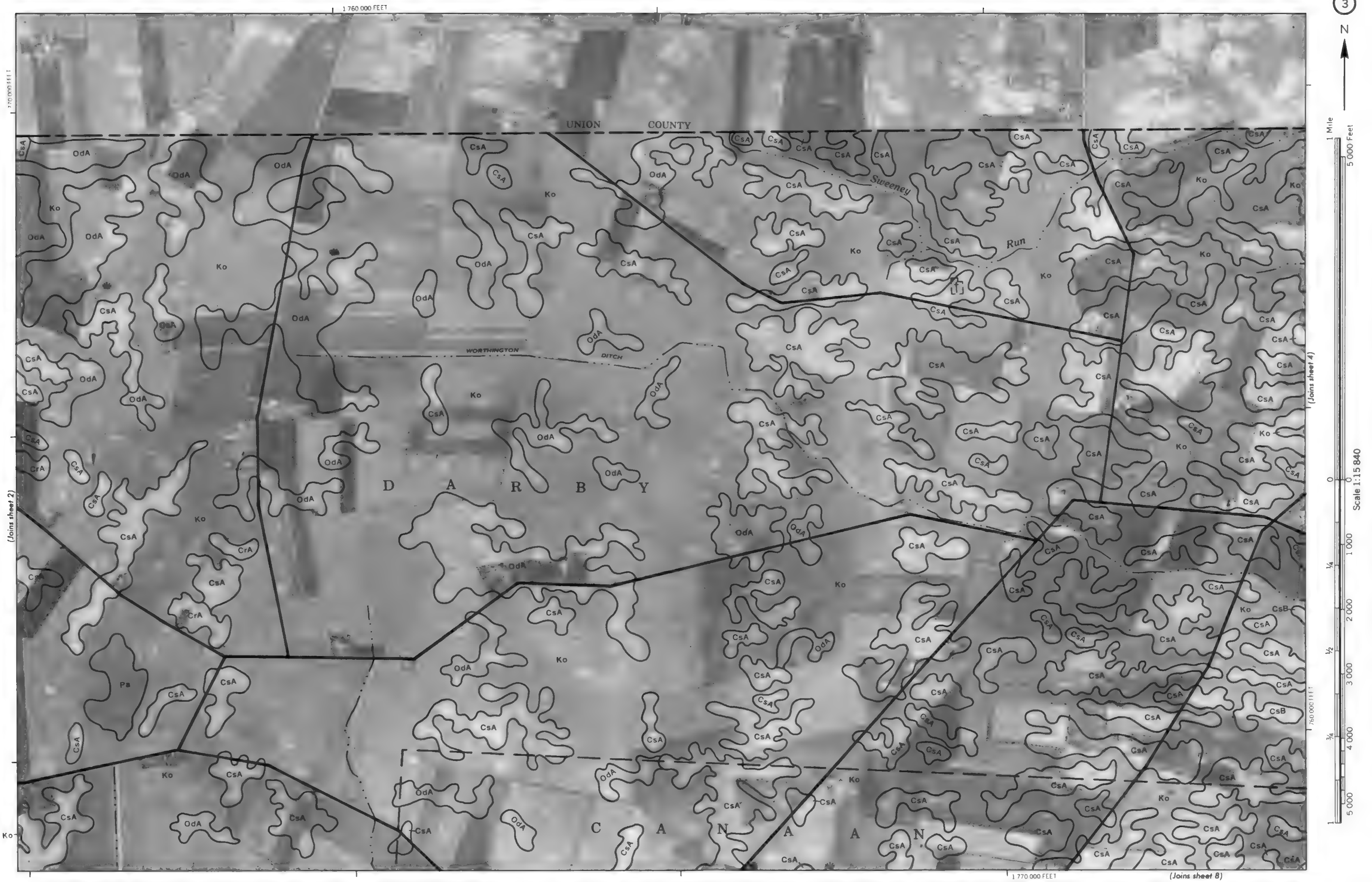
SOIL SAMPLE SITE (normally not shown)

MISCELLANEOUS

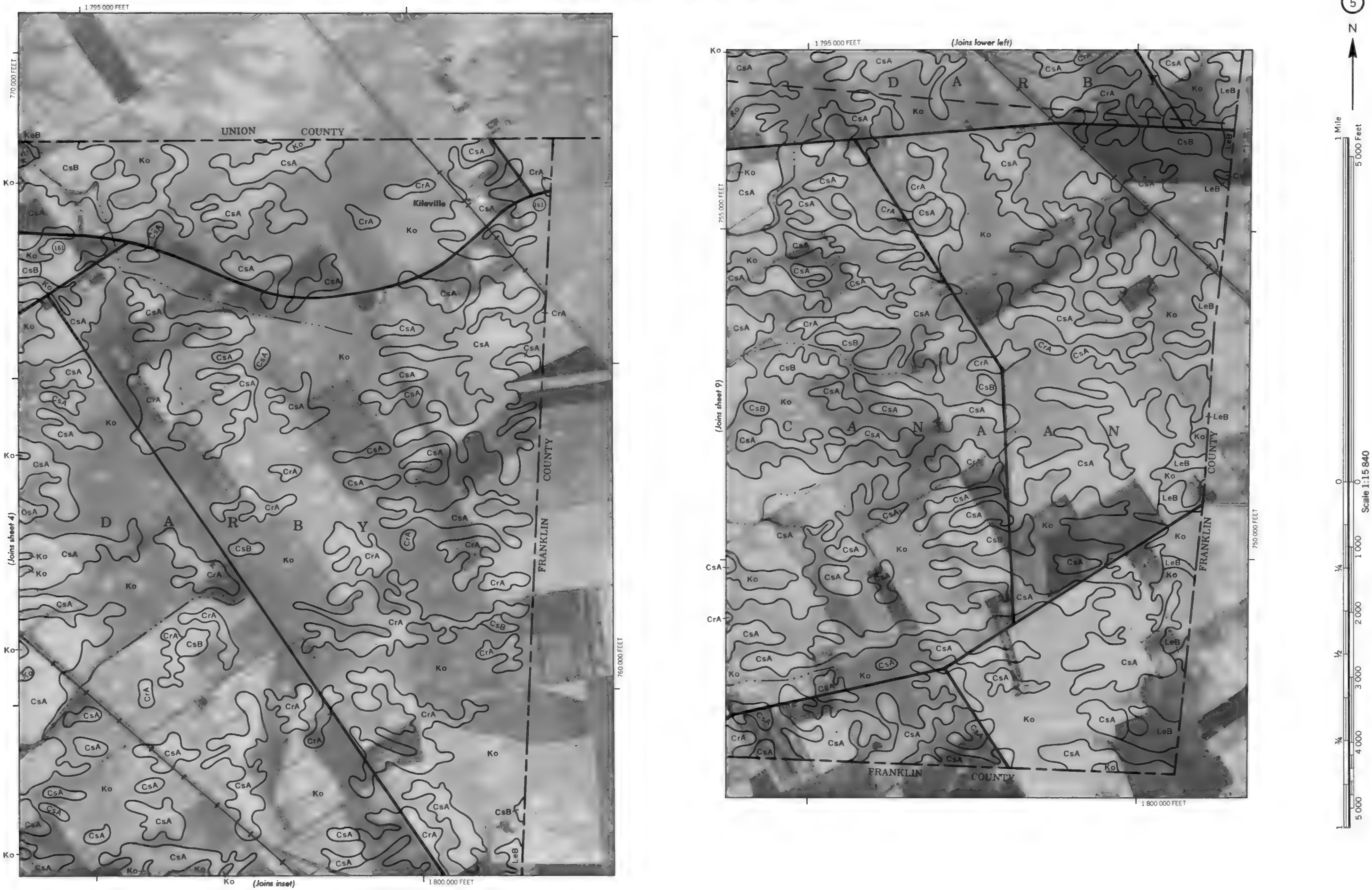
- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot

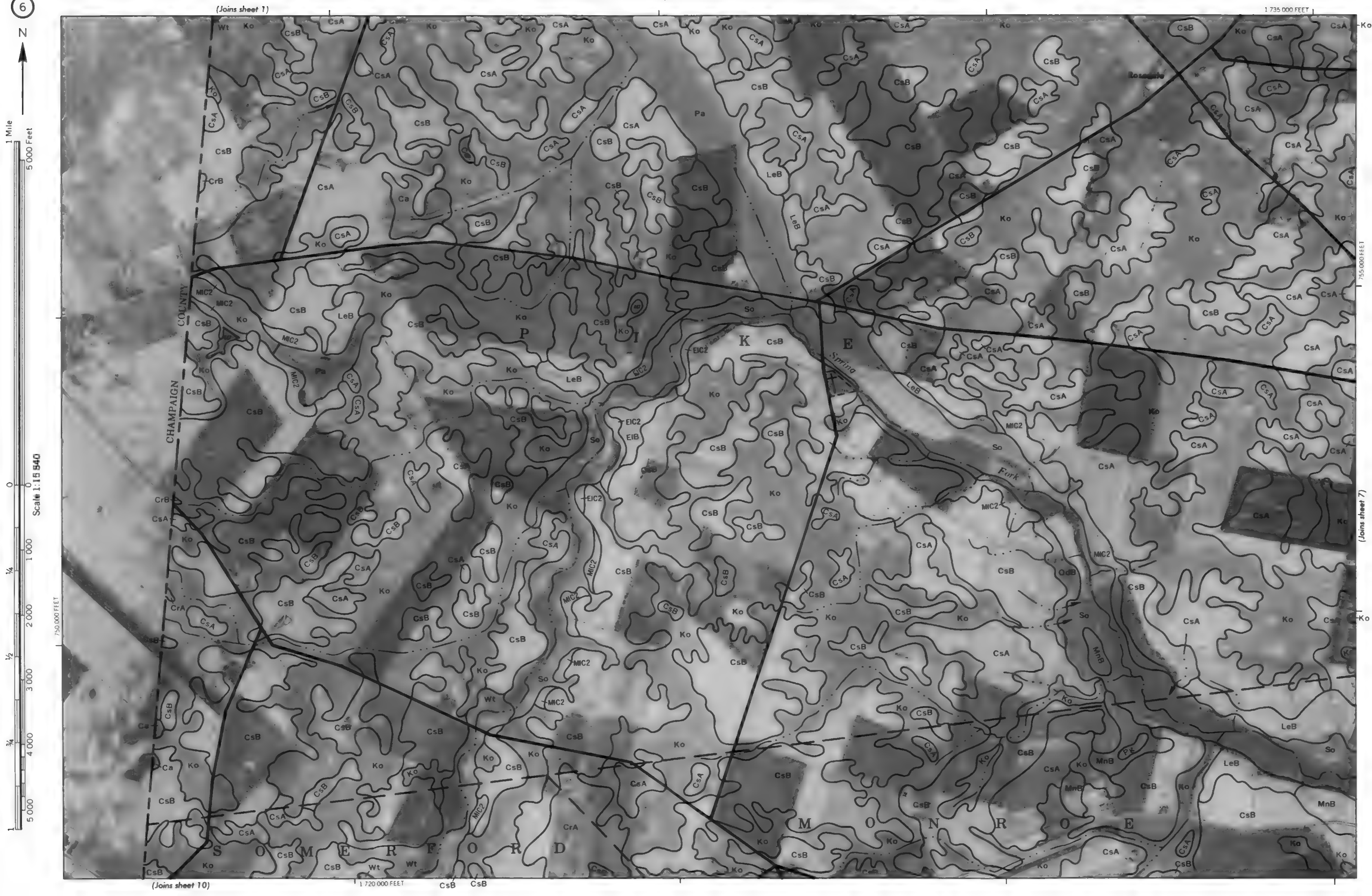

1
N
UNION COUNTY
CHAMPAIGN COUNTY
LITTLE DARBY CREEK
P I K E
Barron Creek
1 720 000 FEET
770 000 FEET
760 000 FEET
1 758 000 FEET
(Joins sheet 2)
(Joins sheet 5)
1 Mile
5 000 Feet
Scale 1:15 840

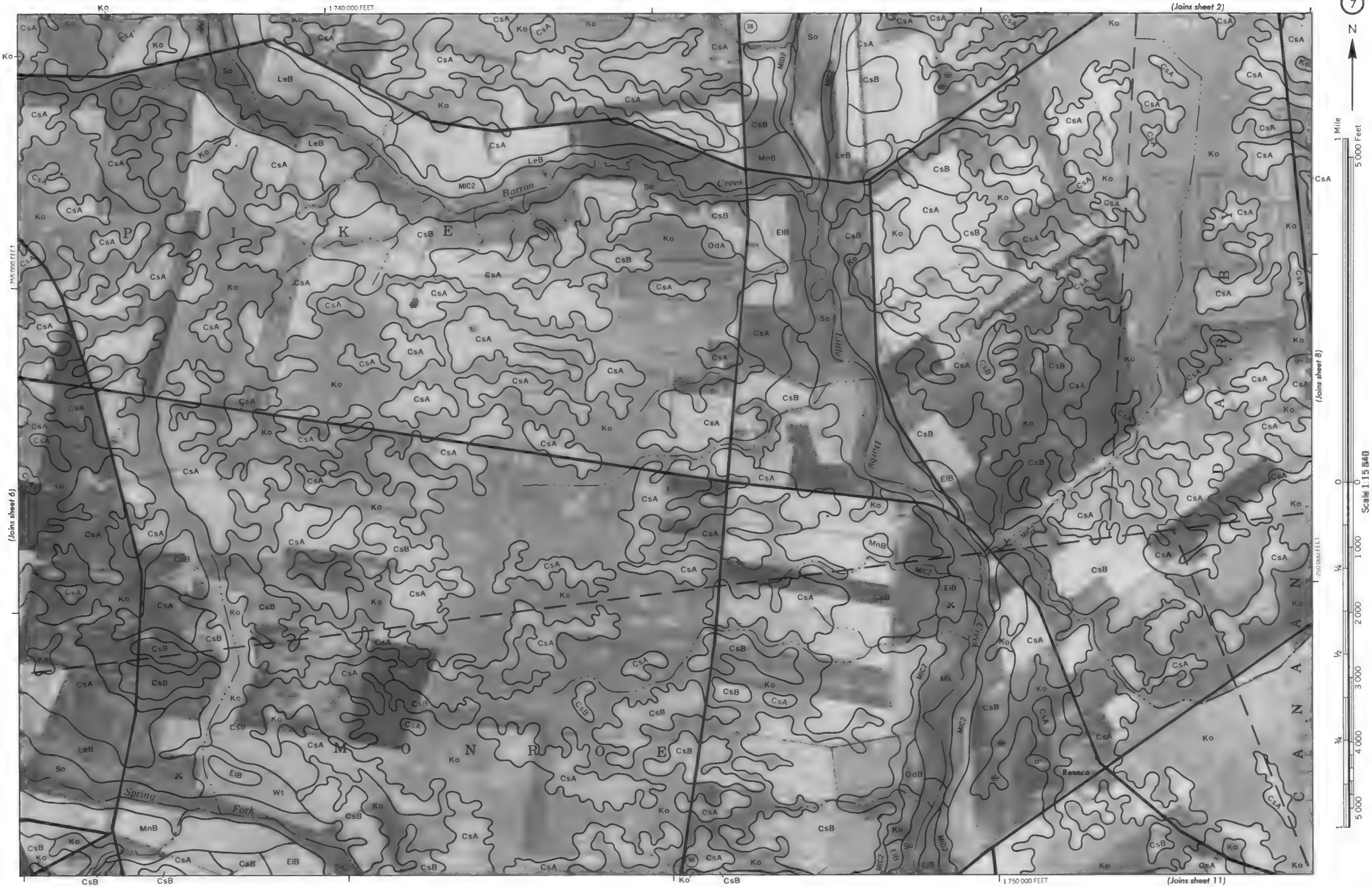

2
N
1 Mile
5 000 Feet
Scale 1:15 840
0
¼
½
¾
1
1 000
2 000
3 000
4 000
5 000
1 755 000 FEET
770 000 FEET
760 000 FEET
1 740 000 FEET
UNION COUNTY
PIKE
DARBY
LITTLE DARBY CREEK
Barron Creek
(Joins sheet 1)
(Joins sheet 3)
(Joins sheet 7)
38
CsA
CsB
CrA
Ko
OdA
LeB
So
Wt
ElB
MlB
MlC2
MlD2

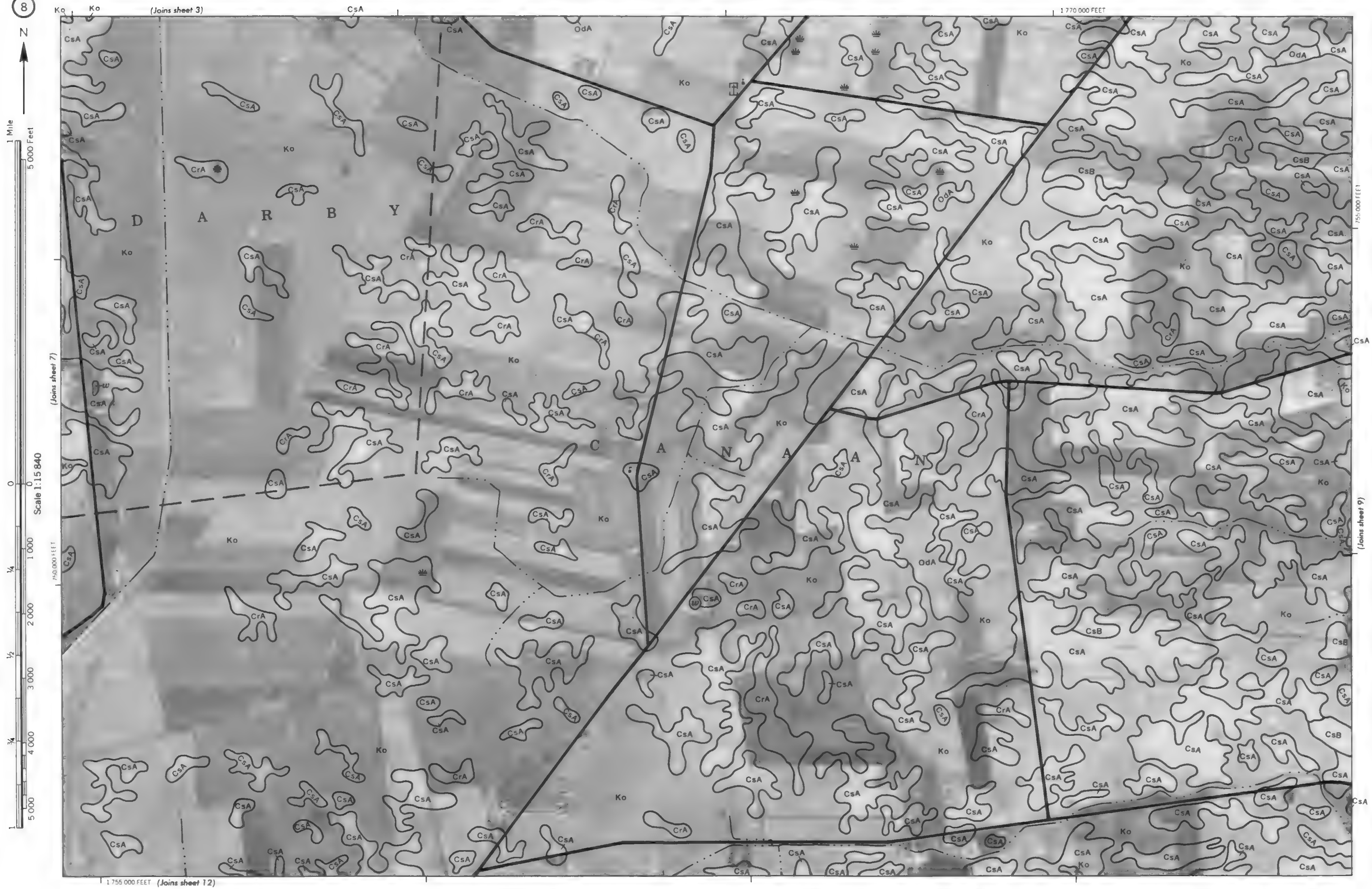

3
N
1 760 000 FEET
UNION COUNTY
Sweeney Run
WORTHINGTON DITCH
D A R B Y
C A N A A N
(Joins sheet 2)
(Joins sheet 4)
(Joins sheet 8)
1 770 000 FEET
760 000 FEET
Scale 1:15 840
1 Mile
5 000 Feet

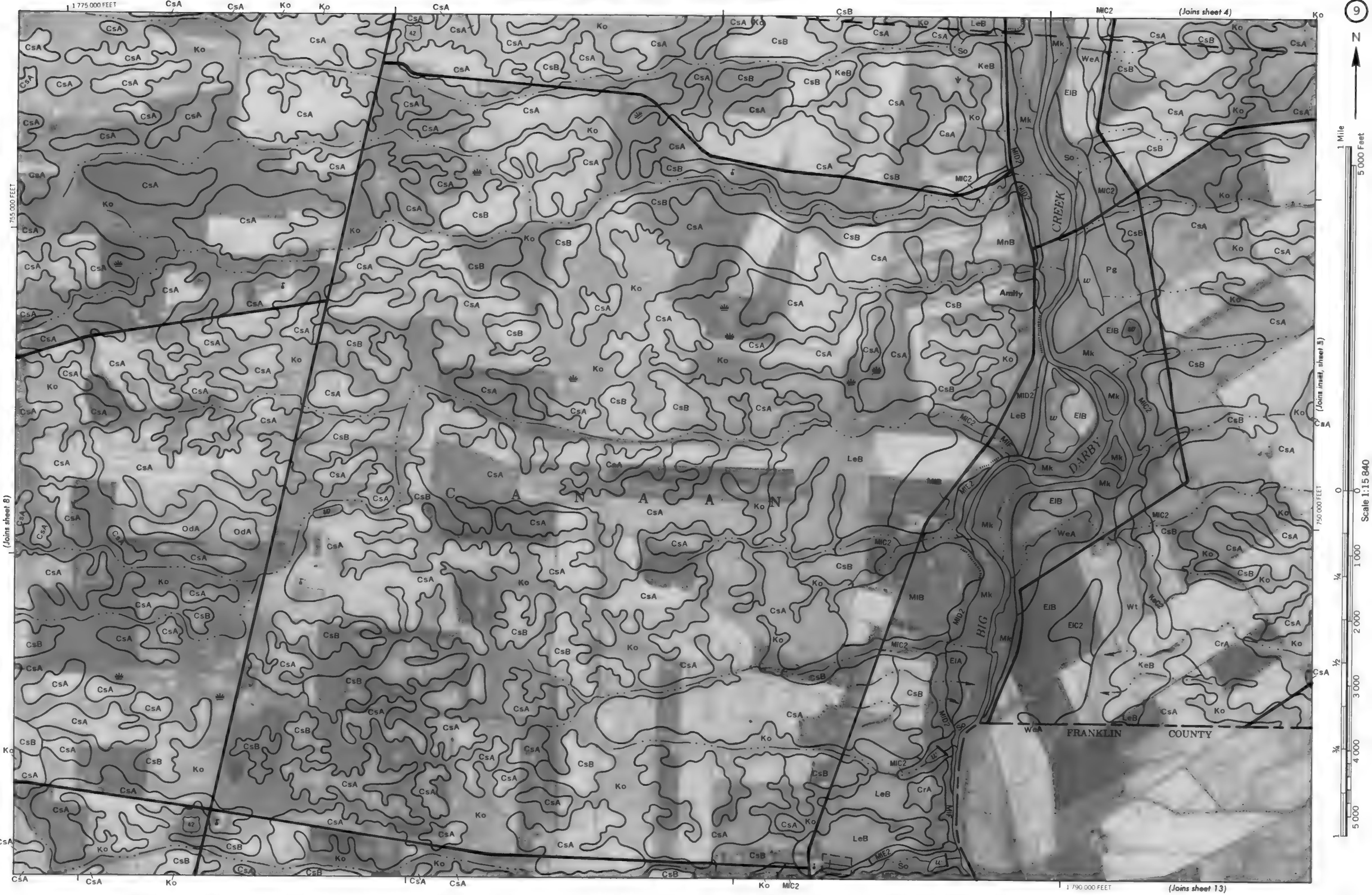

4
N
UNION COUNTY
PLAIN CITY AIRFIELD
PLAIN
CITY
Sweeney Run
Sugar Run
BIG DARBY CREEK
D A R B Y
C A N A A N
WORTHINGTON DITCH
(Joins sheet 3)
(Joins sheet 5)
(Joins sheet 9)
1 790 000 FEET
770 000 FEET
760 000 FEET
1 775 000 FEET
Scale 1:15 840
1 Mile
5 000 Feet
0
1 000
2 000
3 000
4 000
5 000
¼
½
¾
1


5
N
1 795 000 FEET
770 000 FEET
UNION COUNTY
Kileville
DARBY
FRANKLIN COUNTY
(Joins sheet 4)
(Joins inset)
1 800 000 FEET
760 000 FEET
(Joins lower left)
755 000 FEET
750 000 FEET
(Joins sheet 9)
CANAAN
FRANKLIN COUNTY
1 Mile
5 000 Feet
Scale 1:15 840
0
1000
2000
3000
4000
5000
1/4
1/2
3/4
1

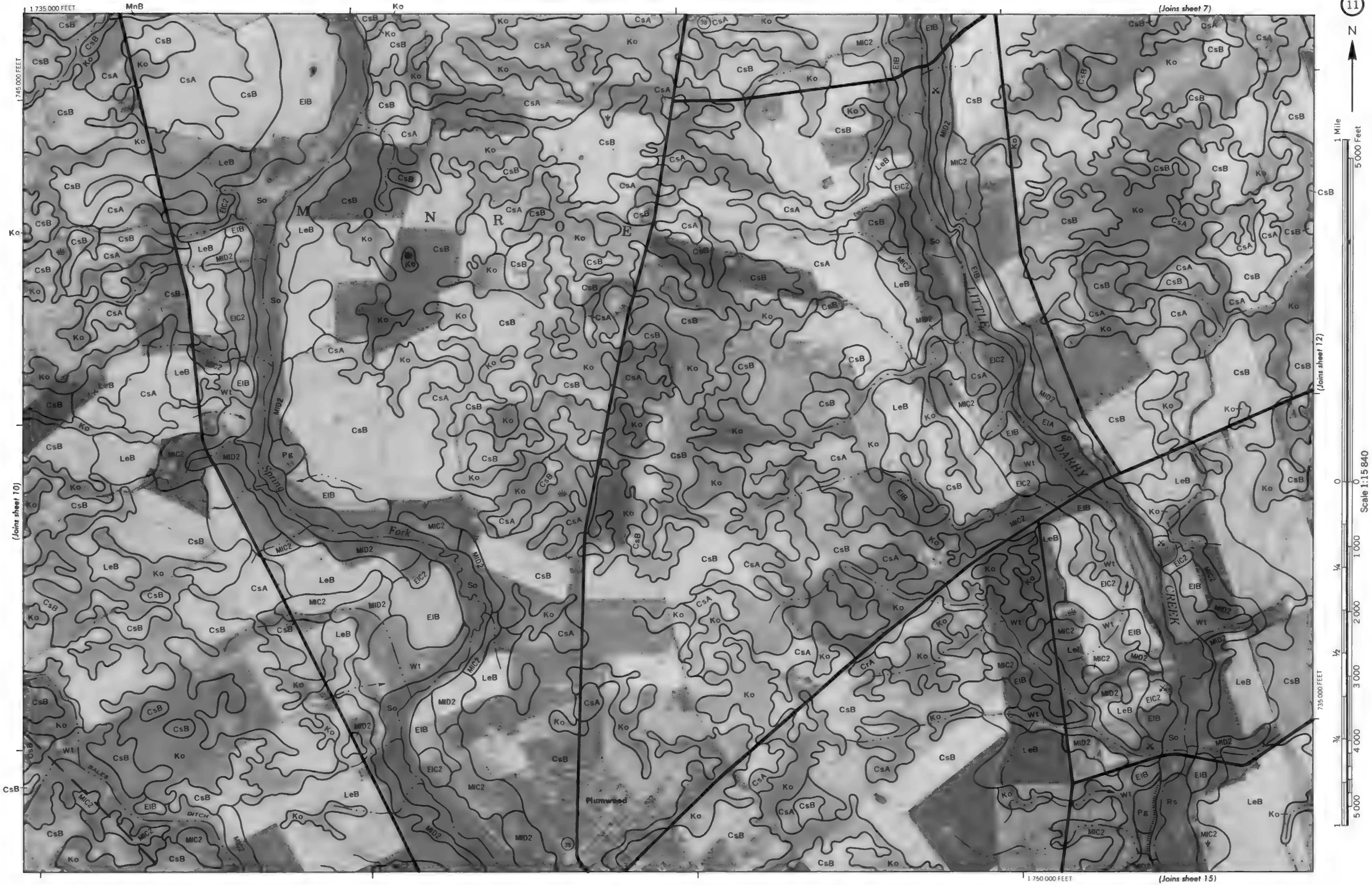

6
N
(Joins sheet 1)
(Joins sheet 7)
(Joins sheet 10)
1 735 000 FEET
755 000 FEET
750 000 FEET
1 720 000 FEET
CHAMPAIGN COUNTY
P I K E
M O N R O E
S O M E R F O R D
Spring Fork
Scale 1:15 840
1 Mile
5 000 Feet
0 1000 2000 3000 4000 5000
0 ¼ ½ ¾ 1

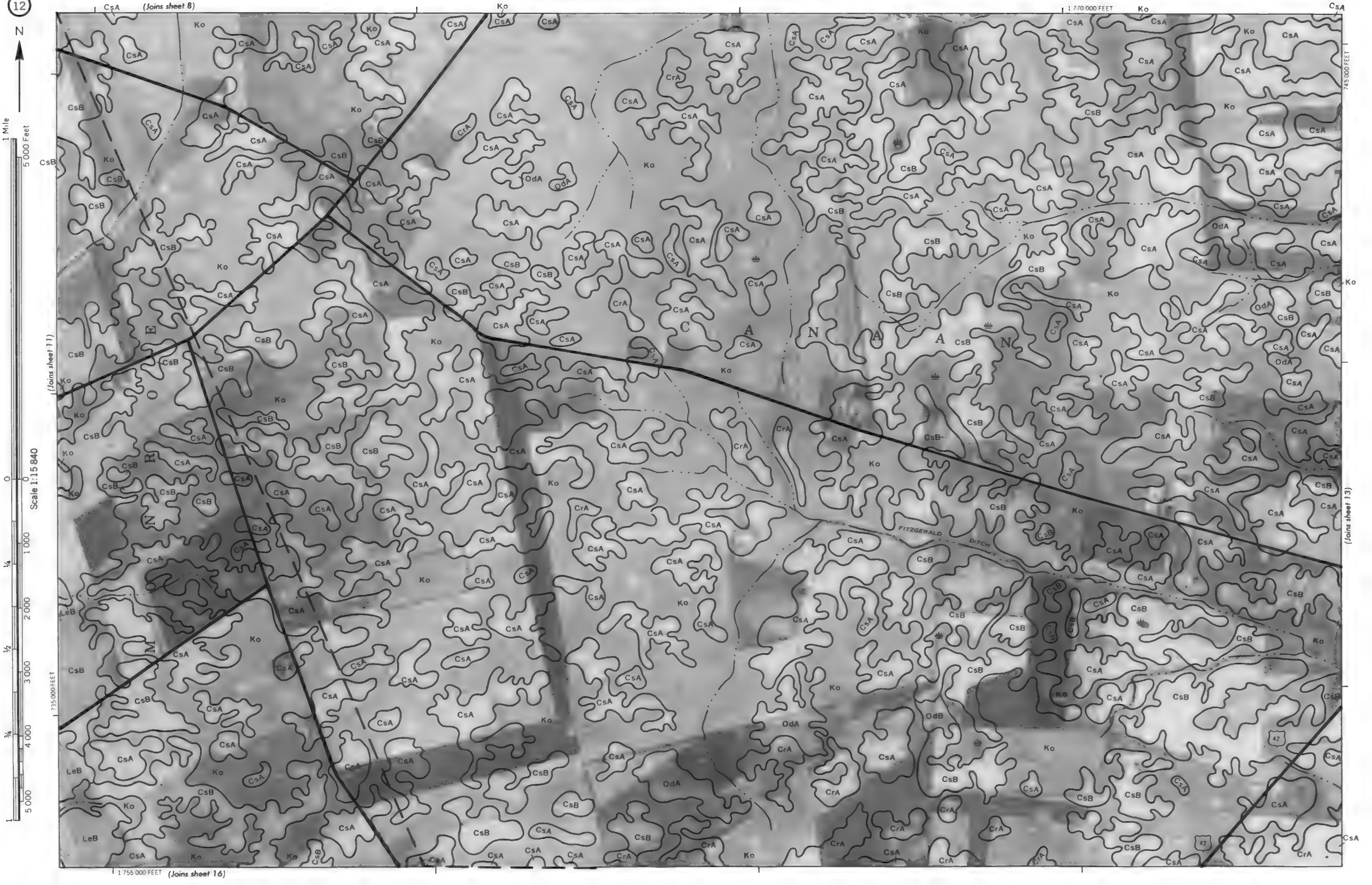

7
N
(Joins sheet 2)
(Joins sheet 6)
(Joins sheet 8)
(Joins sheet 11)
1 740 000 FEET
1 750 000 FEET
755 000 FEET
750 000 FEET
P I K E
M O N R O E
D A R B Y
C A N A A N
Barron Creek
Little Darby
Spring Fork
38
1 Mile
5 000 Feet
Scale 1:15 840

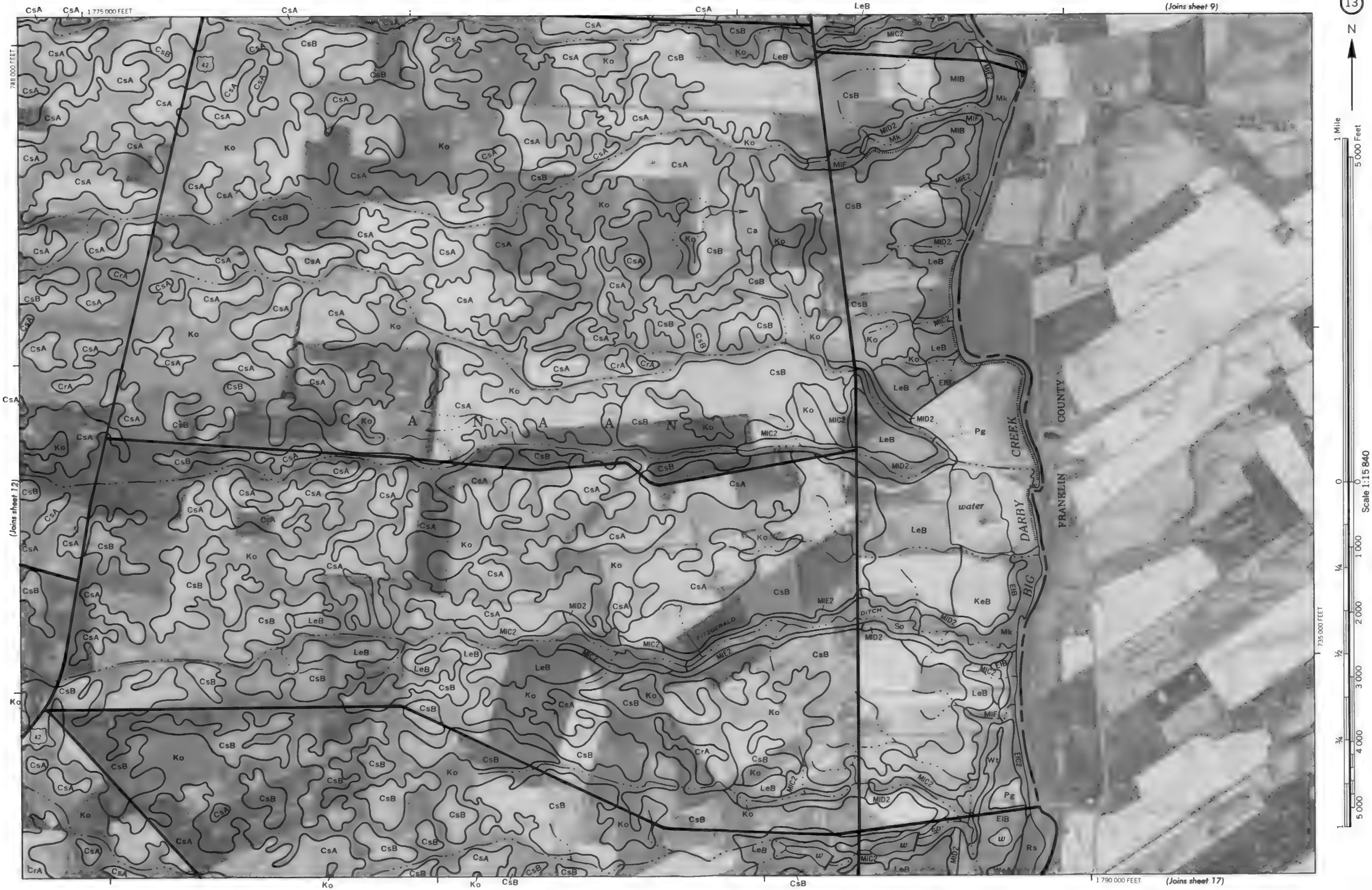

8
N
1 Mile
5 000 Feet
Scale 1:15 840
0
¼
½
¾
1
1 000
2 000
3 000
4 000
5 000
(Joins sheet 3)
(Joins sheet 7)
(Joins sheet 9)
(Joins sheet 12)
1 770 000 FEET
755 000 FEET
750 000 FEET
1 755 000 FEET
D A R B Y
C A N A A N
Ko
CsA
CrA
OdA
CsB

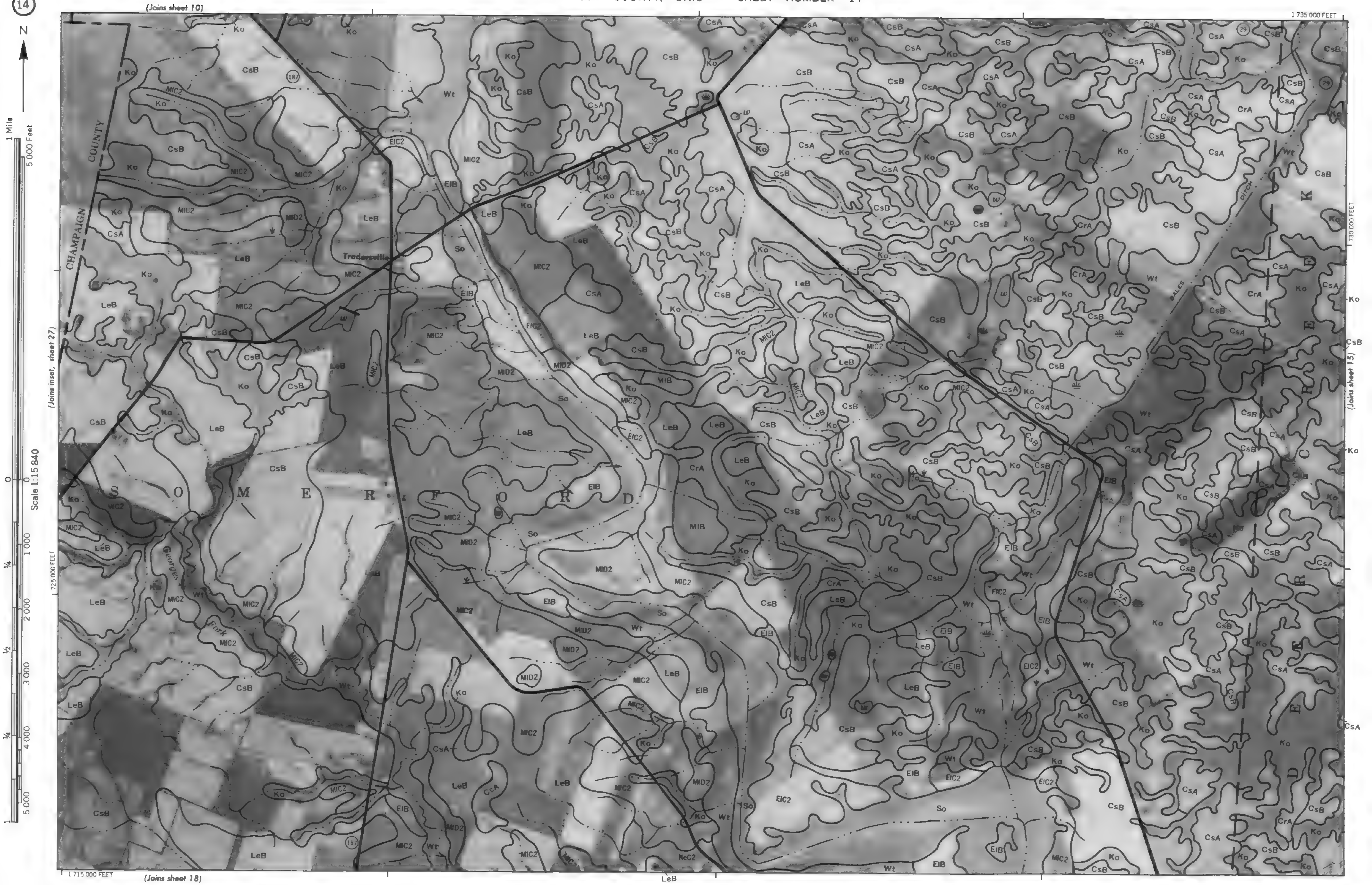

(Joins sheet 4)
(Joins sheet 13)
(Joins sheet 8)
(Joins inset, sheet 5)
1 775 000 FEET
1 790 000 FEET
755 000 FEET
750 000 FEET
CANAAN
BIG DARBY CREEK
Amity
FRANKLIN COUNTY
N
9
Scale 1:15 840
1 Mile
5 000 Feet

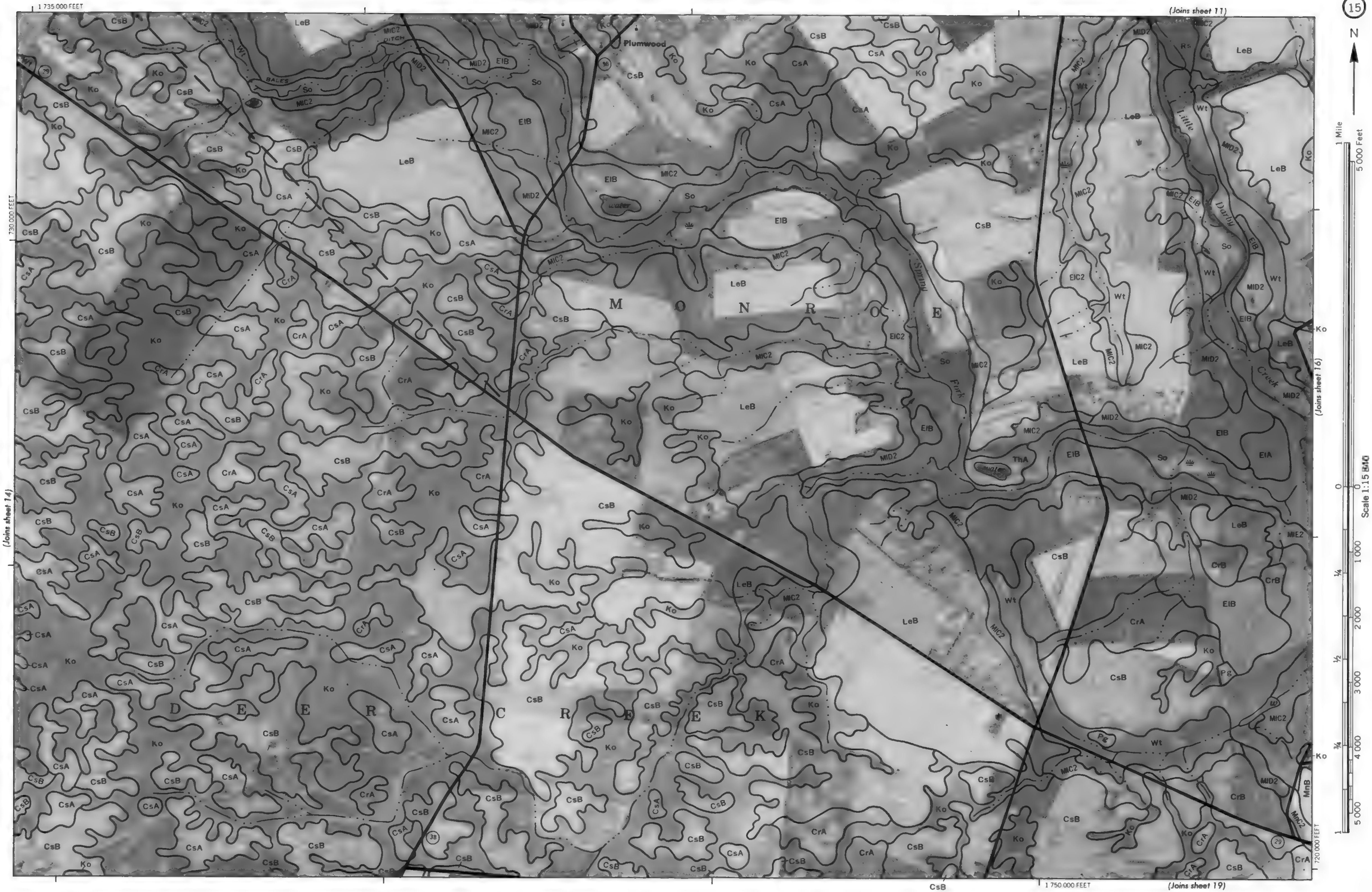

10
N
(Joins sheet 6)
(Joins sheet 11)
(Joins sheet 14)
1 735 000 FEET
745 000 FEET
1 720 000 FEET
235 000 FEET
CHAMPAIGN COUNTY
CLARK COUNTY
SOMERFORD
MONROE
Spring
Fork
1 Mile
5 000 Feet
Scale 1:15 840
0
1/4
1/2
3/4
1
1 000
2 000
3 000
4 000
5 000

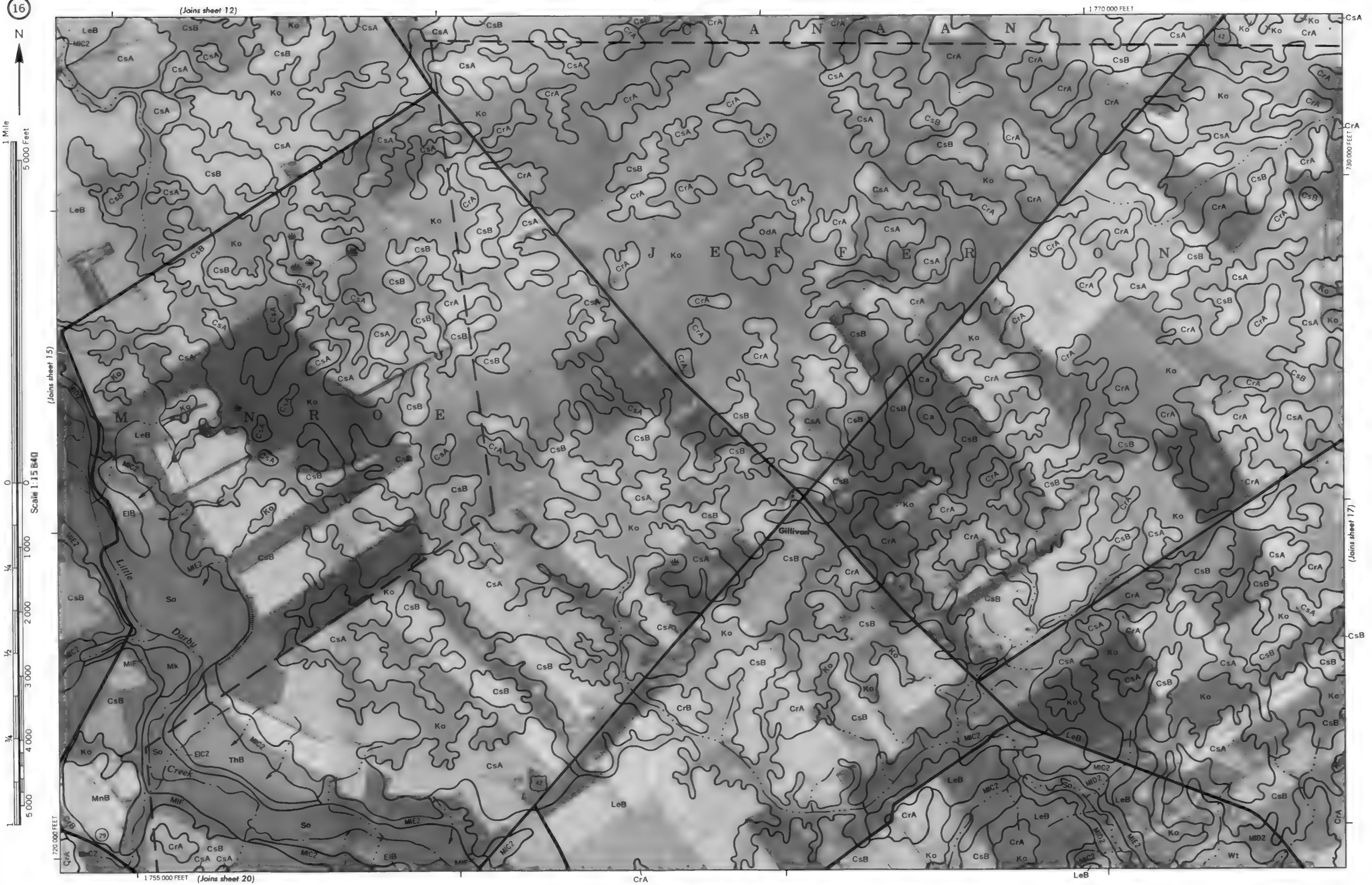

11
N
(Joins sheet 7)
(Joins sheet 10)
(Joins sheet 12)
(Joins sheet 15)
1 735 000 FEET
1 750 000 FEET
745 000 FEET
735 000 FEET
MONROE
LITTLE DARBY CREEK
Spring Fork
BALES DITCH
Plumwood
Scale 1:15 840
1 Mile
5 000 Feet

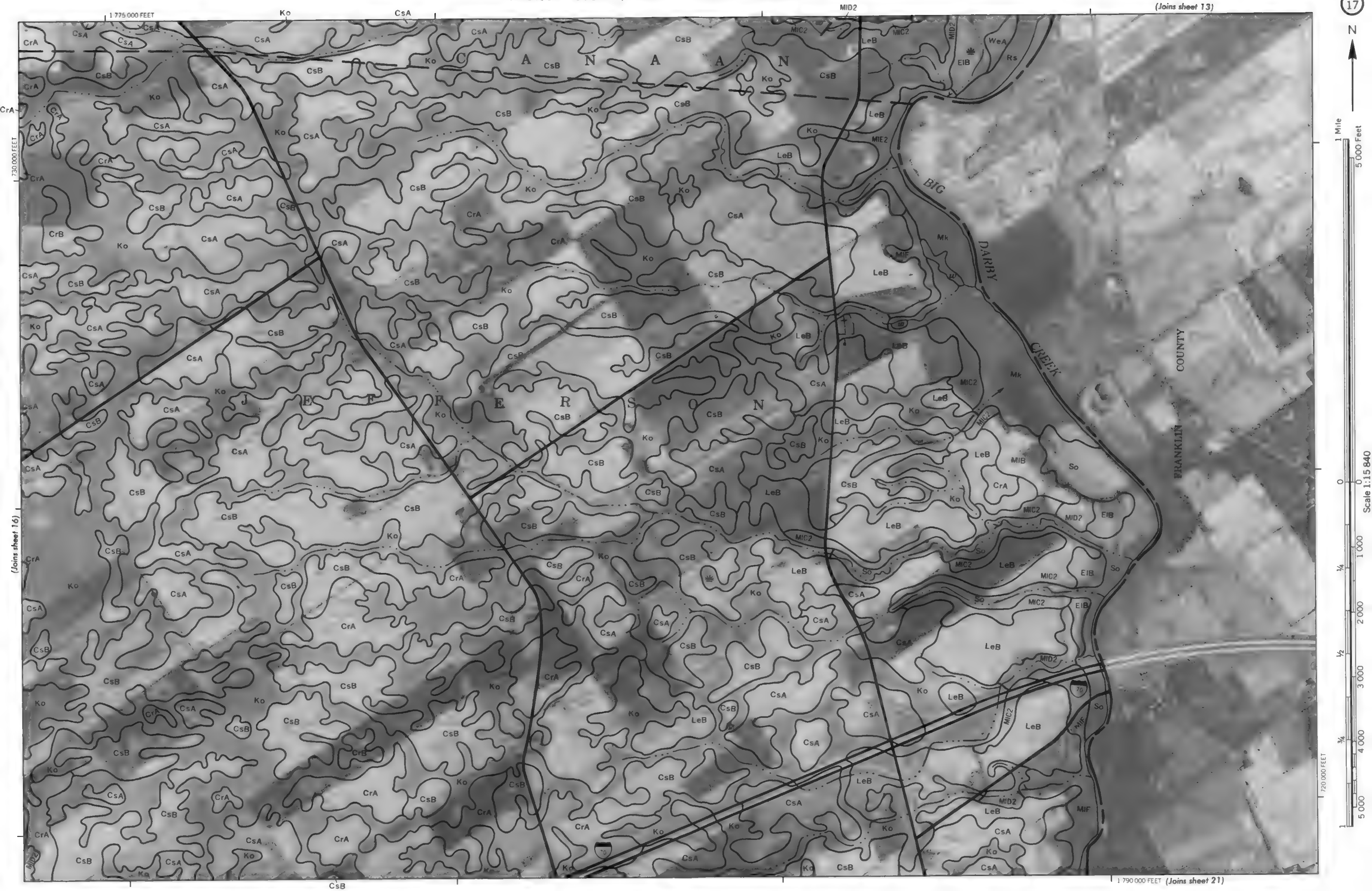

N
(Joins sheet 8)
(Joins sheet 11)
(Joins sheet 13)
(Joins sheet 16)
1 770 000 FEET
745 000 FEET
735 000 FEET
1 755 000 FEET
CANAAN
FITZGERALD DITCH
42
Scale 1:15 840
1 Mile
5 000 Feet
CsA
CsB
Ko
CrA
OdA
OdB
LeB

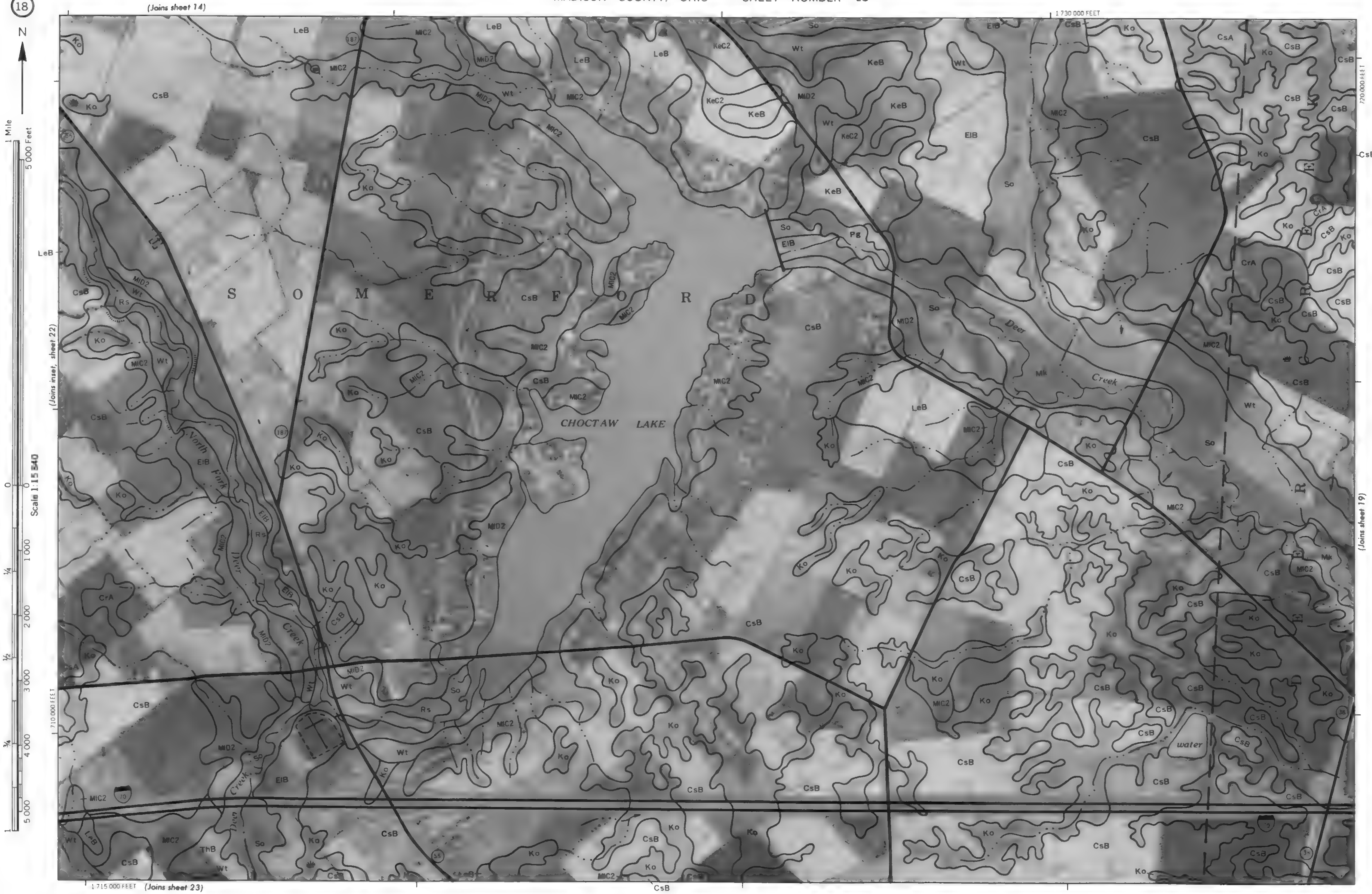

13
(Joins sheet 9)
(Joins sheet 12)
(Joins sheet 17)
1 775 000 FEET
1 790 000 FEET
735 000 FEET
N
1 Mile
5 000 Feet
Scale 1:15 840
FRANKLIN COUNTY
BIG DARBY CREEK
FITZGERALD DITCH
water
CANAAN

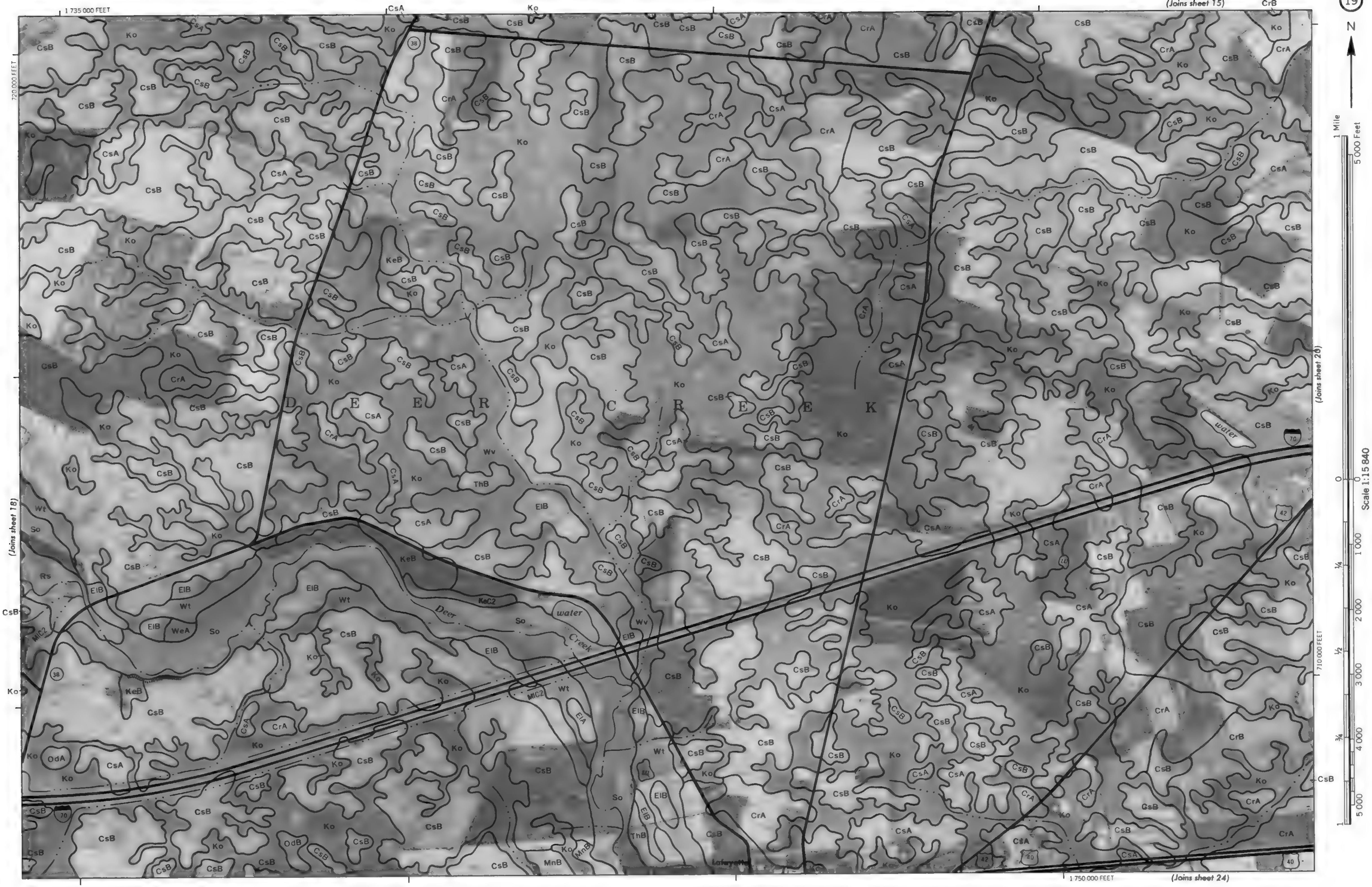

N
(Joins sheet 10)
(Joins sheet 18)
(Joins inset, sheet 27)
(Joins sheet 15)
1 735 000 FEET
730 000 FEET
725 000 FEET
1 715 000 FEET
1 Mile
5 000 Feet
Scale 1:15 840
CHAMPAIGN COUNTY
SOMERFORD
DEER CREEK
Tradersville
George Fork
BALES DITCH
CsA
CsB
CrA
Ko
LeB
MlC2
MlD2
MlB
ElB
ElC2
So
Wt
NeC2
187
29


15
N
1 735 000 FEET
730 000 FEET
720 000 FEET
1 750 000 FEET
(Joins sheet 11)
(Joins sheet 14)
(Joins sheet 16)
(Joins sheet 19)
Plumwood
BALES DITCH
M O N R O E
D E E R C R E E K
Spring Fork
Little Darby Creek
water
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
2 000
3 000
4 000
5 000
¼
½
¾
1

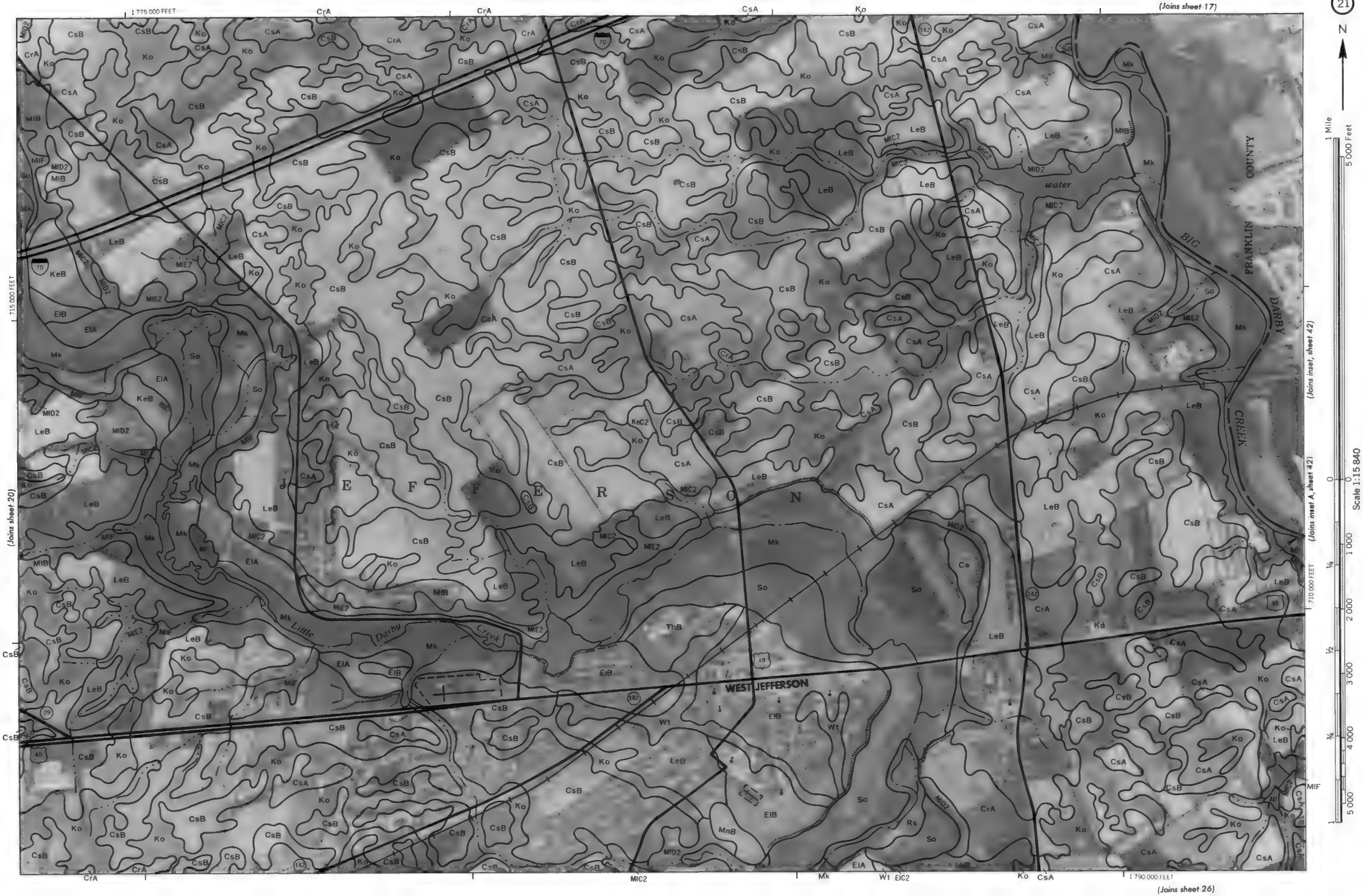

16
N
(Joins sheet 12)
(Joins sheet 15)
(Joins sheet 17)
(Joins sheet 20)
1 770 000 FEET
1 755 000 FEET
730 000 FEET
720 000 FEET
Scale 1:15 840
1 Mile
5 000 Feet
C A N A A N
J E F F E R S O N
M O N R O E
Gilliyan
Little Darby Creek
42
29

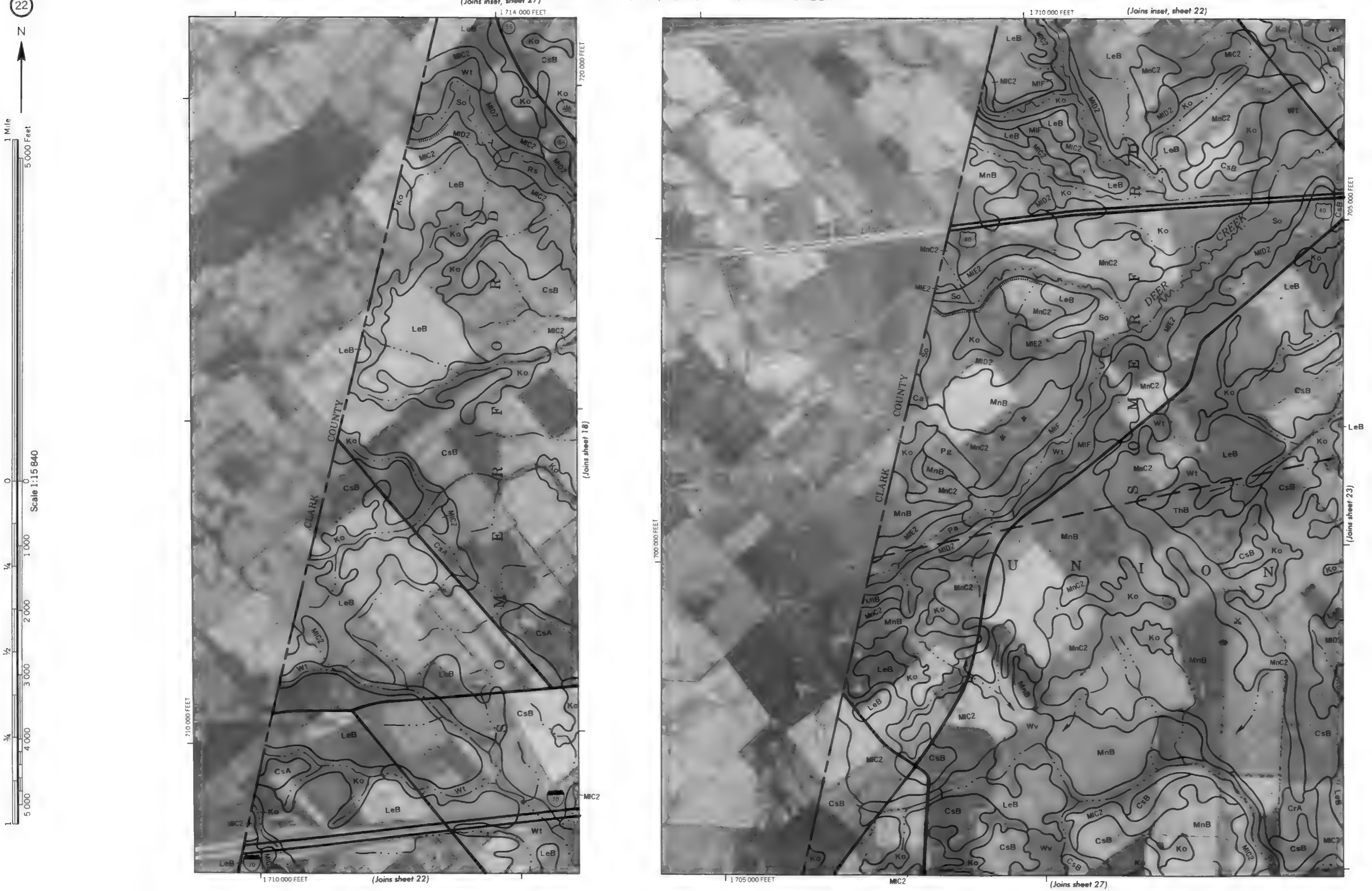

(Joins sheet 13)
(Joins sheet 16)
1 790 000 FEET (Joins sheet 21)
1 775 000 FEET
730 000 FEET
720 000 FEET
C A N A A N
J E F F E R S O N
BIG DARBY CREEK
FRANKLIN COUNTY
N
1 Mile
5 000 Feet
Scale 1:15 840
0
1000
2000
3000
4000
5000
¼
½
¾
1
CsA
CsB
CrA
CrB
Ko
LeB
MlC2
MlD2
MlE2
MlB
MlF
Mk
So
ElB
WeA
Rs

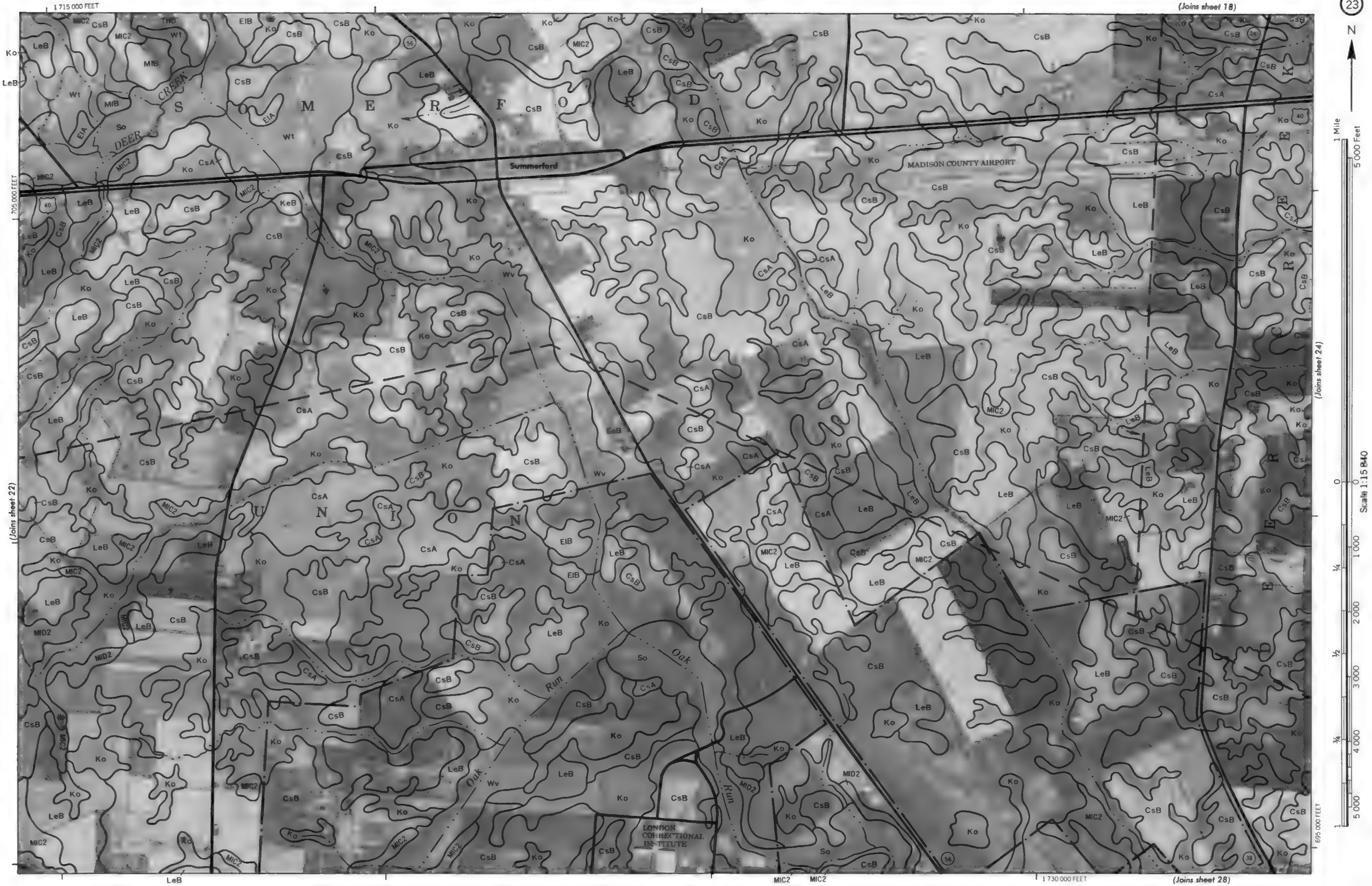

18
N
(Joins sheet 14)
1 730 000 FEET
720 000 FEET
710 000 FEET
1 715 000 FEET
(Joins sheet 23)
(Joins inset, sheet 22)
(Joins sheet 19)
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
2 000
3 000
4 000
5 000
¼
½
¾
S O M E R F O R D
CHOCTAW LAKE
North Fork
Deer Creek
Deer Creek
Deer Creek
E K R R C E E D
water
LeB
CsB
Ko
MlC2
MlD2
Wt
KeB
KeC2
ElB
So
Pg
Rs
CrA
CsA
Mk
ThB


19
N
1 735 000 FEET
720 000 FEET
(Joins sheet 15)
(Joins sheet 18)
(Joins sheet 20)
(Joins sheet 24)
1 750 000 FEET
710 000 FEET
D E E R C R E E K
Deer Creek
water
Lafayette
1 Mile
5 000 Feet
Scale 1:15 840

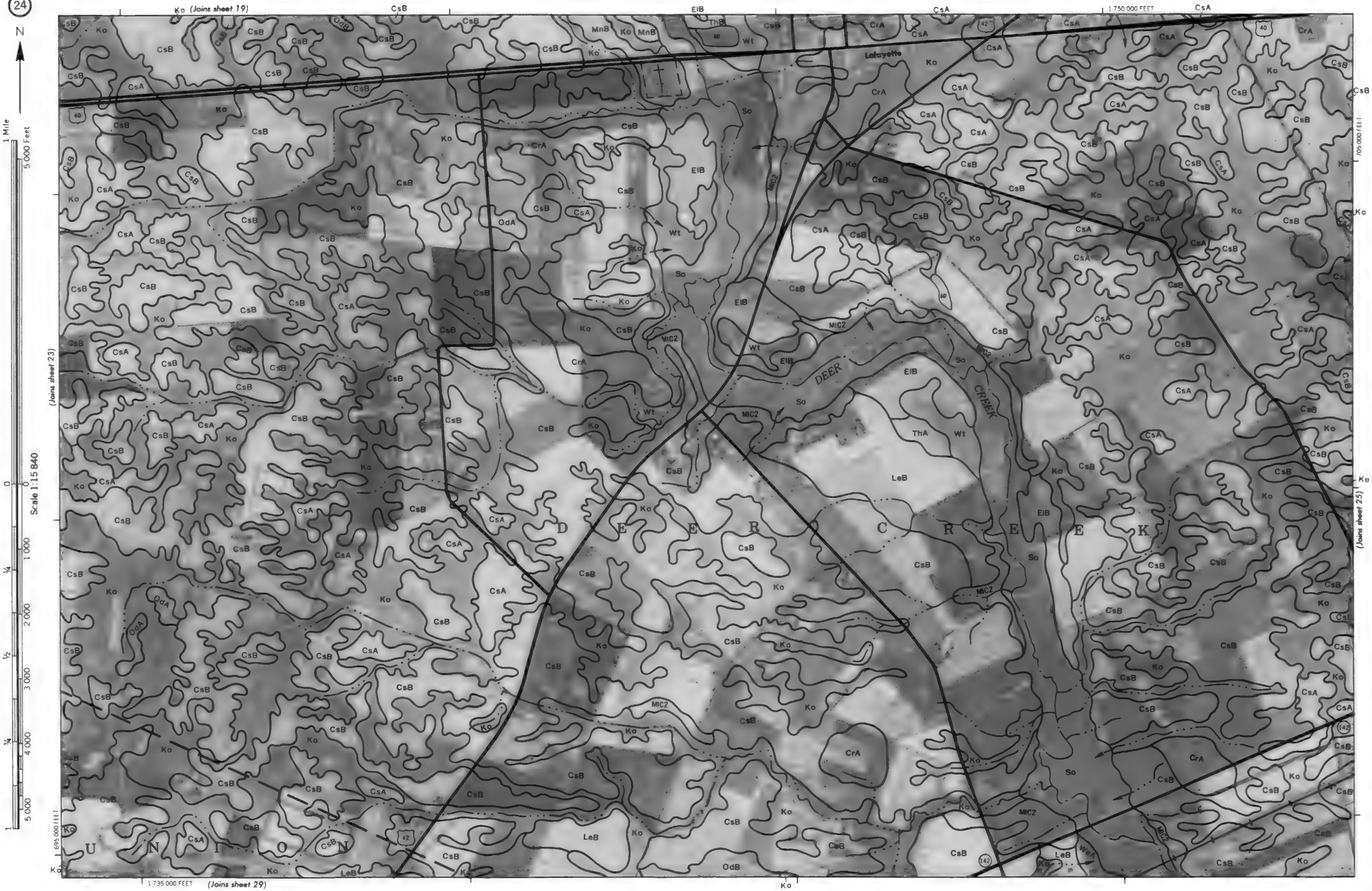

20
N
1 755 000 FEET
(Joins sheet 16)
(Joins sheet 19)
(Joins sheet 21)
(Joins sheet 25)
720 000 FEET
710 000 FEET
1 770 000 FEET
1 Mile
5 000 Feet
Scale 1:15 840
LITTLE DARBY CREEK
JEFFERSON
Glade Run
water

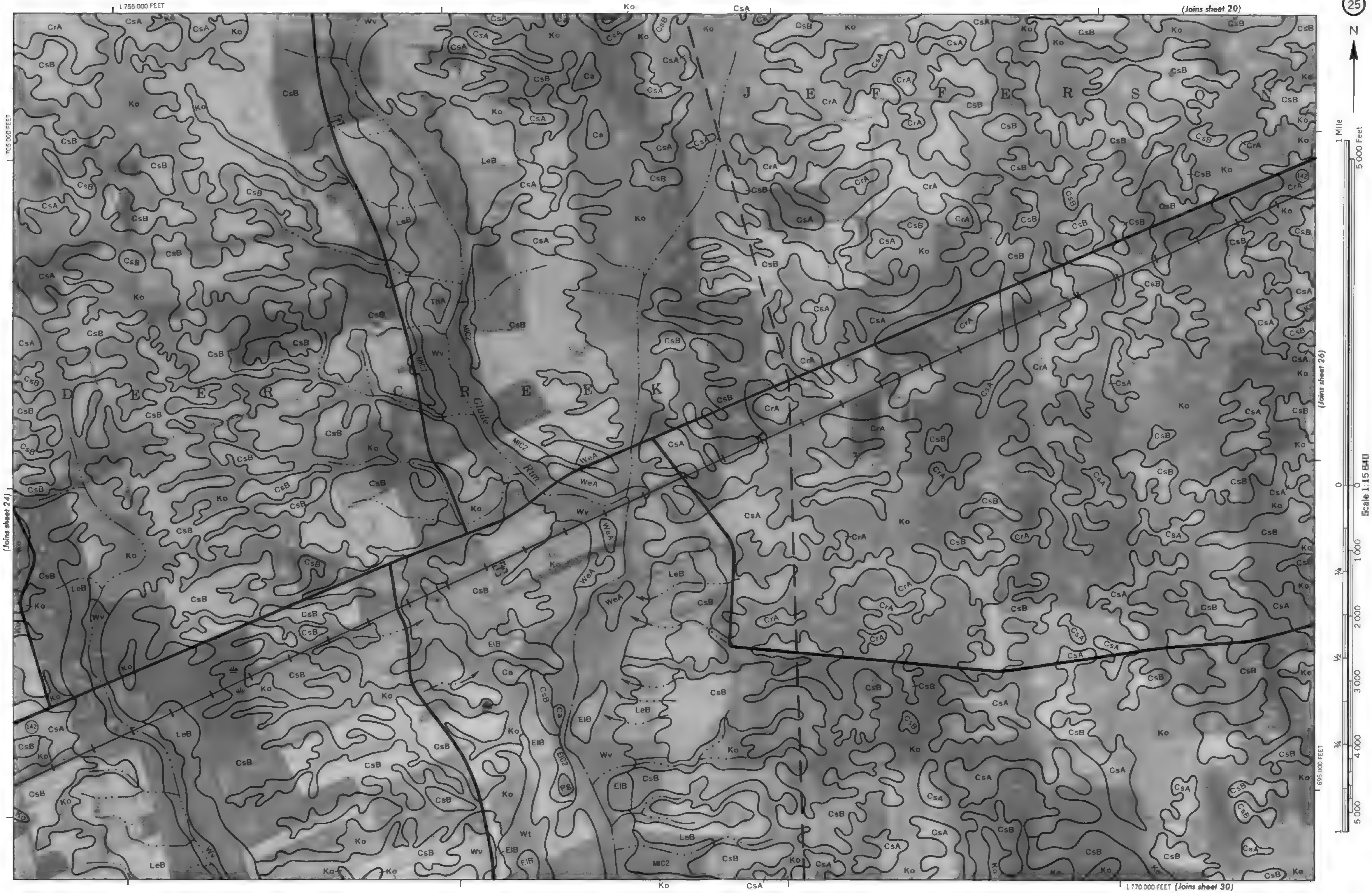

21
N
(Joins sheet 17)
(Joins sheet 20)
(Joins inset, sheet 42)
(Joins inset A, sheet 42)
(Joins sheet 26)
1 775 000 FEET
1 790 000 FEET
715 000 FEET
710 000 FEET
J E F F E R S O N
WEST JEFFERSON
Little Darby Creek
BIG DARBY CREEK
FRANKLIN COUNTY
water
1 Mile
5 000 Feet
Scale 1:15 840

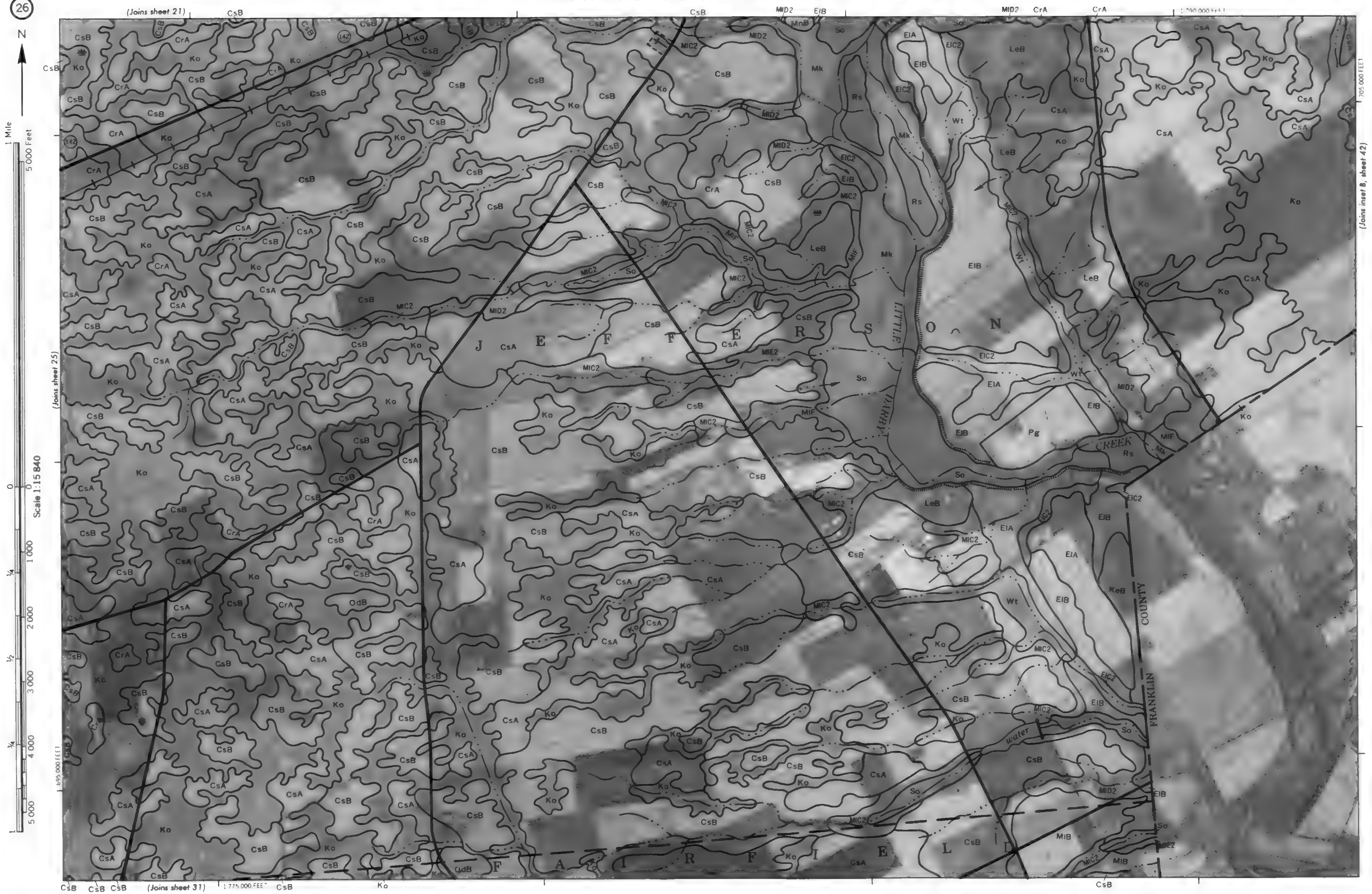

22
N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins inset, sheet 27)
1 714 000 FEET
720 000 FEET
(Joins sheet 18)
710 000 FEET
1 710 000 FEET
(Joins sheet 22)
CLARK COUNTY
D E R F O M
E R F
(Joins inset, sheet 22)
1 710 000 FEET
705 000 FEET
700 000 FEET
1 705 000 FEET
(Joins sheet 23)
(Joins sheet 27)
DEER CREEK
U N I O N
D E R F E M S O R
LeB
Ko
CsB
CsA
MlC2
MlD2
MlE2
MlF
MnB
MnC2
Wt
So
Rs
Ca
Pg
ThB
Wv
CrA

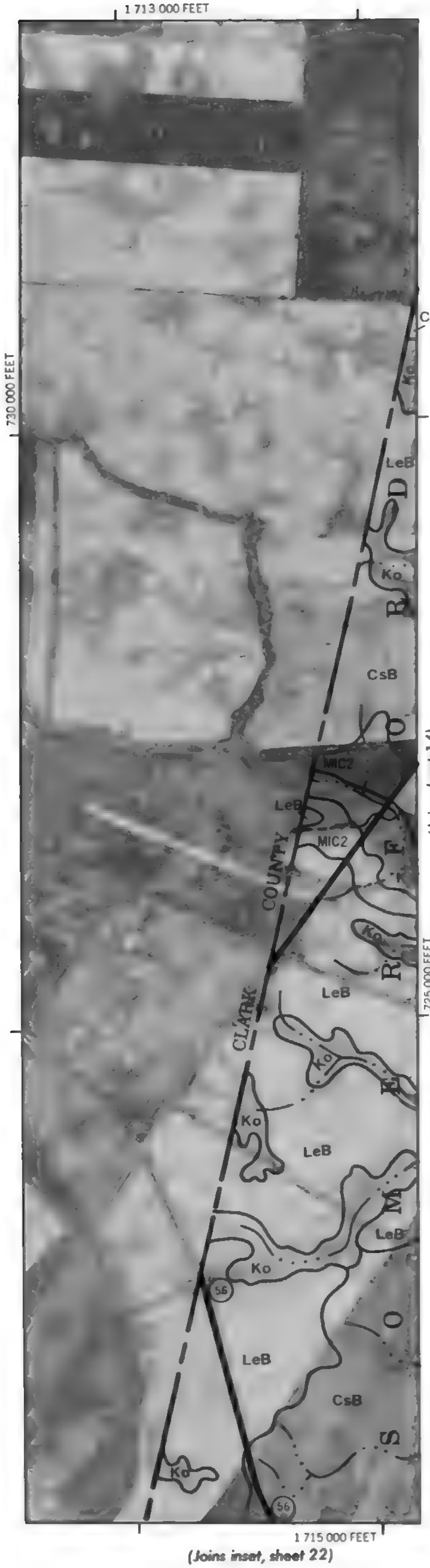

23
N
1 715 000 FEET
(Joins sheet 18)
(Joins sheet 22)
(Joins sheet 24)
(Joins sheet 28)
705 000 FEET
695 000 FEET
1 730 000 FEET
SOMERFORD
UNION
DEER CREEK
Summerford
MADISON COUNTY AIRPORT
Oak Run
LONDON CORRECTIONAL INSTITUTE
40
56
38
1 Mile
5 000 Feet
Scale 1:15 840
0
1000
2000
3000
4000
5000
¼
½
¾
1

24

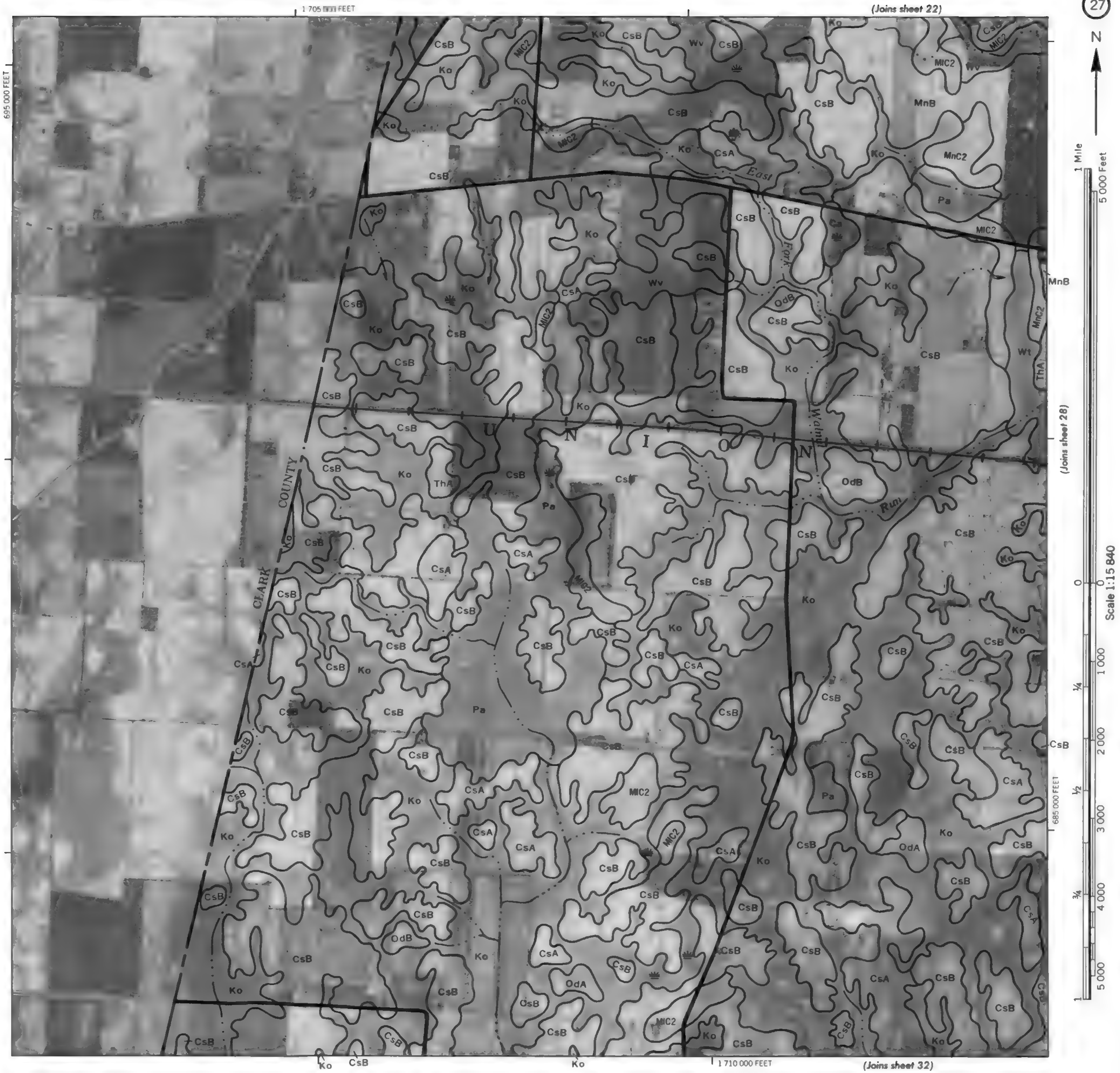

N
Ko (Joins sheet 19)
(Joins sheet 23)
(Joins sheet 25)
(Joins sheet 29)
1 750 000 FEET
1 735 000 FEET
705 000 FEET
695 000 FEET
Lafayette
DEER CREEK
D E E R C R E E K
U N I O N
40
42
142
1 Mile
5 000 Feet
Scale 1:15 840
0
1000
2000
3000
4000
5000
¼
½
¾
1


25
1 755 000 FEET
(Joins sheet 20)
705 000 FEET
(Joins sheet 24)
(Joins sheet 26)
695 000 FEET
1 770 000 FEET (Joins sheet 30)
J E F F E R S O N
D E E R C R E E K
Glade Run
N
1 Mile
5 000 Feet
Scale 1:15 840
0
1/4
1/2
3/4
1
0
1 000
2 000
3 000
4 000
5 000
142
Ko
CsA
CsB
CrA
Ca
LeB
MlC2
Wv
WeA
ElB
ElC2
TlA
Wt
Pg

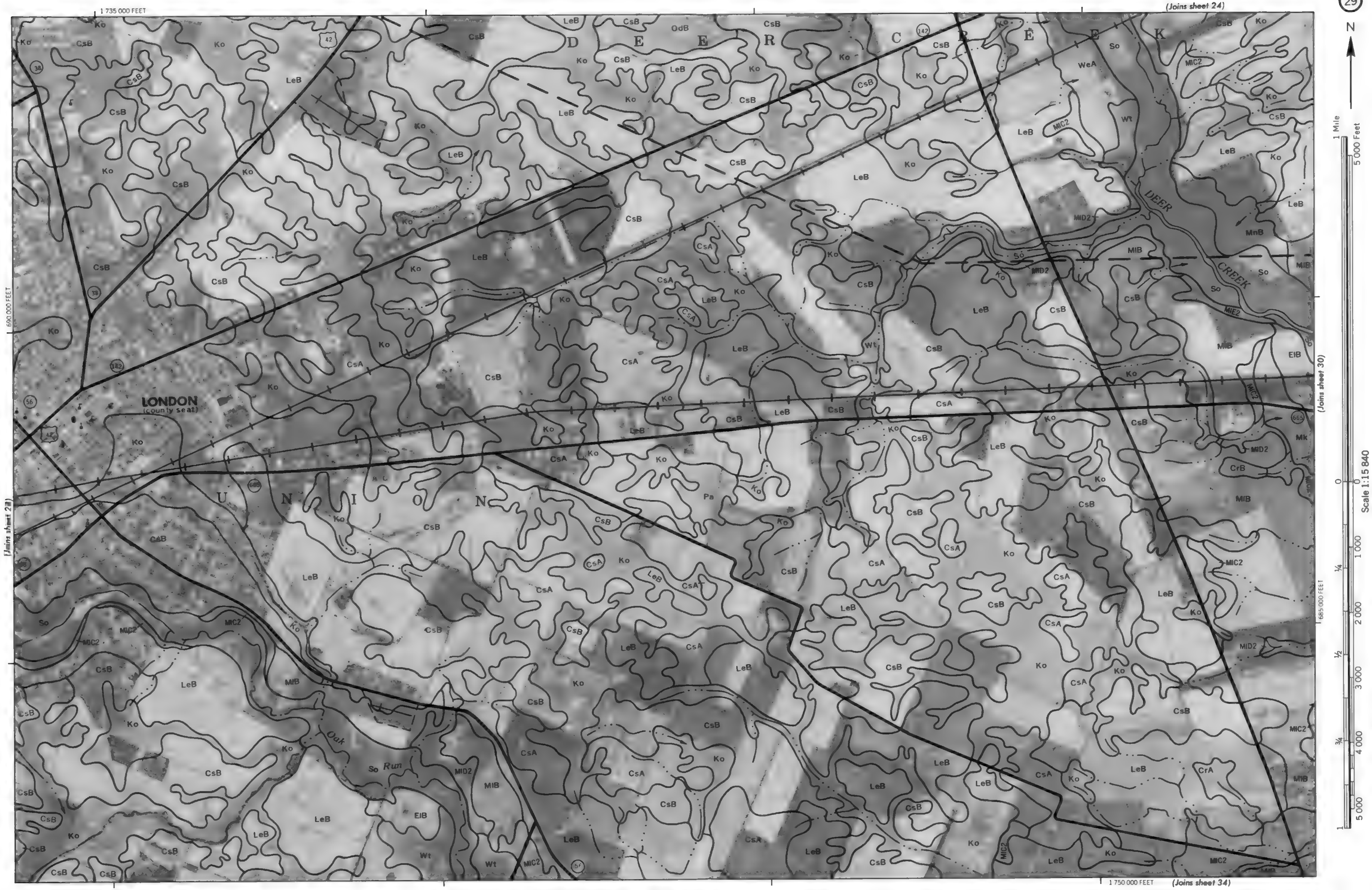

26
N
(Joins sheet 21)
(Joins sheet 25)
(Joins sheet 31)
(Joins inset B, sheet 42)
1 Mile
5 000 Feet
Scale 1:15 840
JEFFERSON
FAIRFIELD
LITTLE DARBY CREEK
FRANKLIN COUNTY
1 775 000 FEET
695 000 FEET
705 000 FEET

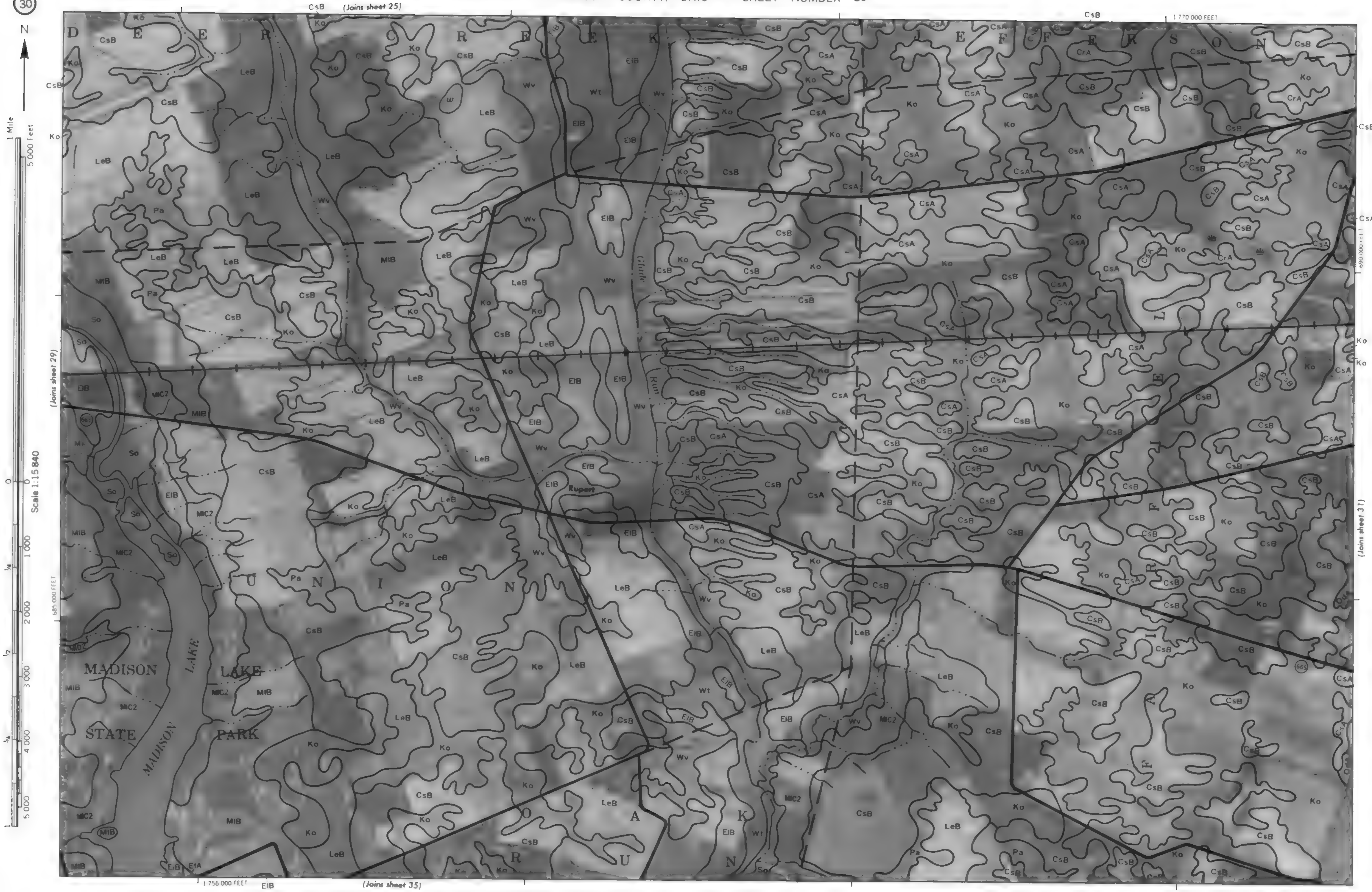


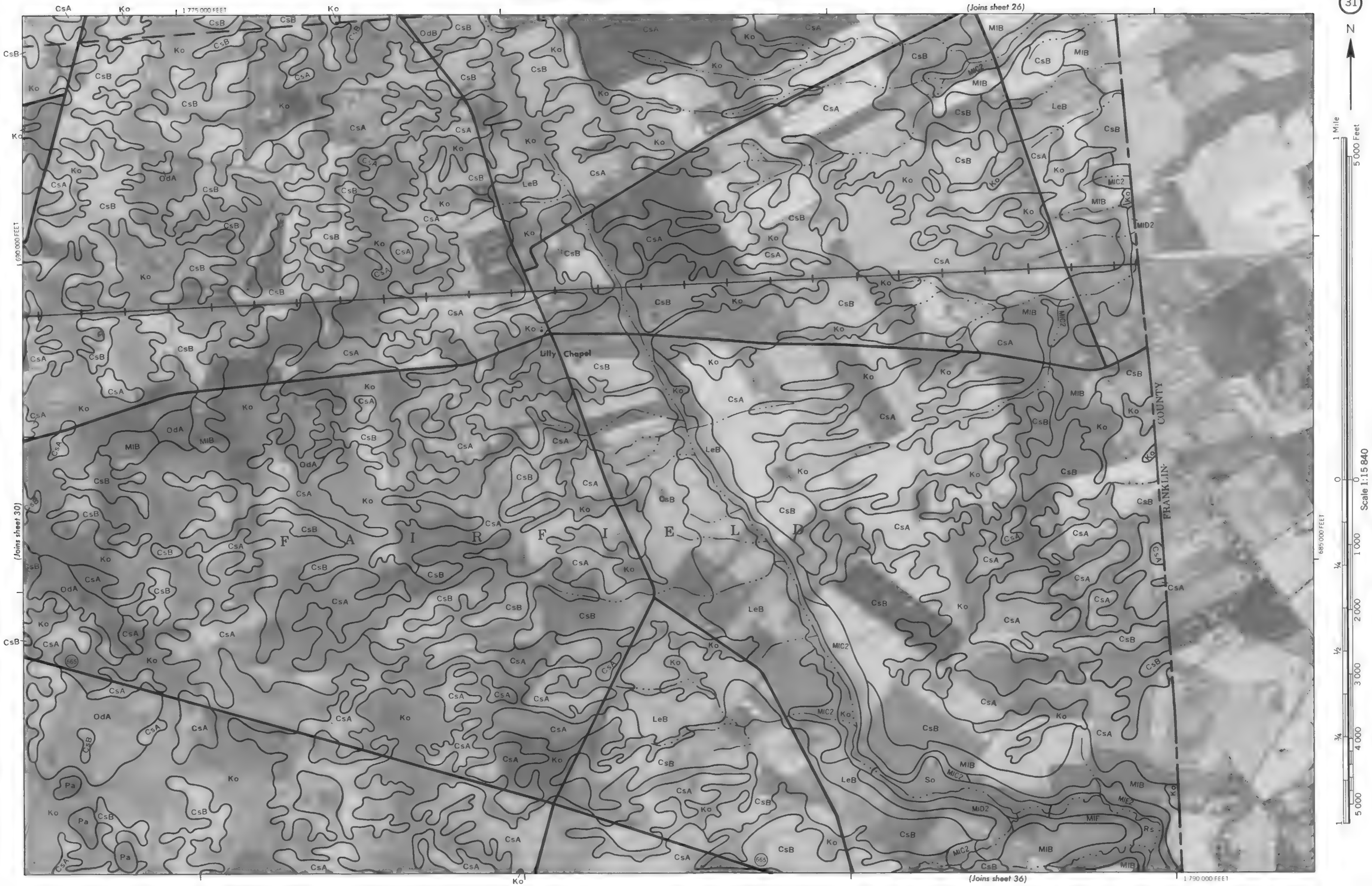
2000 AND 5000-FOOT GRID TICKS




28
N
(Joins sheet 23)
(Joins sheet 27)
(Joins sheet 29)
(Joins sheet 33)
Scale 1:15 840
1 Mile
5 000 Feet
LONDON CORRECTIONAL INSTITUTE
Oak Run
East Fork Walnut Run
U N I O N
LONDON
(county seat)


29
N
1 735 000 FEET
(Joins sheet 24)
(Joins sheet 30)
(Joins sheet 28)
(Joins sheet 34)
690 000 FEET
685 000 FEET
1 750 000 FEET
D E E R C R E E K
DEER CREEK
U N I O N
LONDON
(county seat)
Oak Run
1 Mile
5 000 Feet
Scale 1:15 840

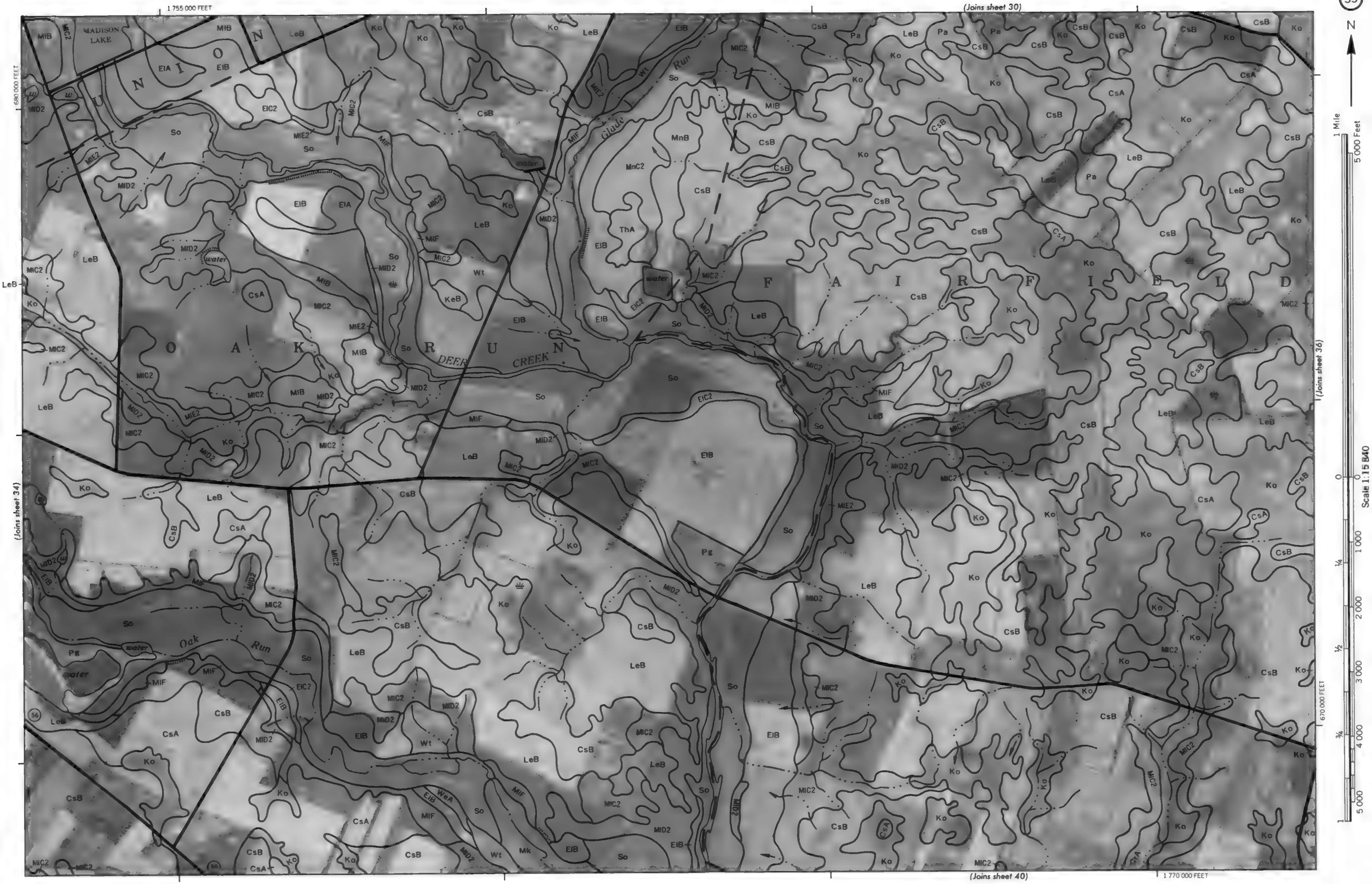

30
N
(Joins sheet 25)
(Joins sheet 29)
(Joins sheet 31)
(Joins sheet 35)
DEERCREEK
JEFFERSON
UNION
FAIRFIELD
OAK RUN
MADISON LAKE STATE PARK
MADISON LAKE
Glade Run
Rupert
1 770 000 FEET
1 755 000 FEET
690 000 FEET
685 000 FEET
1 Mile
5 000 Feet
Scale 1:15 840
0
1000
2000
3000
4000
5000
CsB
CsA
CrA
Ko
LeB
ElB
ElA
Wv
Wt
MlB
MlC2
Pa
So


(Joins sheet 26)
(Joins sheet 30)
(Joins sheet 36)
1 775 000 FEET
1 790 000 FEET
690 000 FEET
685 000 FEET
Lilly Chapel
F A I R F I E L D
FRANKLIN COUNTY
665
N
1 Mile
5 000 Feet
Scale 1:15 840
0
¼
½
¾
1
1000
2000
3000
4000
5000
CsA
CsB
Ko
OdA
OdB
LeB
MlB
MlC2
MlD2
MlE2
MlF
MiD2
So
Rs
Pa


32
N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 27)
(Joins sheet 33)
(Joins sheet 37)
1 710 000 FEET
680 000 FEET
670 000 FEET
1 695 000 FEET
U N I O N
P A I N T
CLARK COUNTY
Florence
Paint Creek
CsB
CsA
Ko
LeB
CrA
OdA
MlC2
Ca

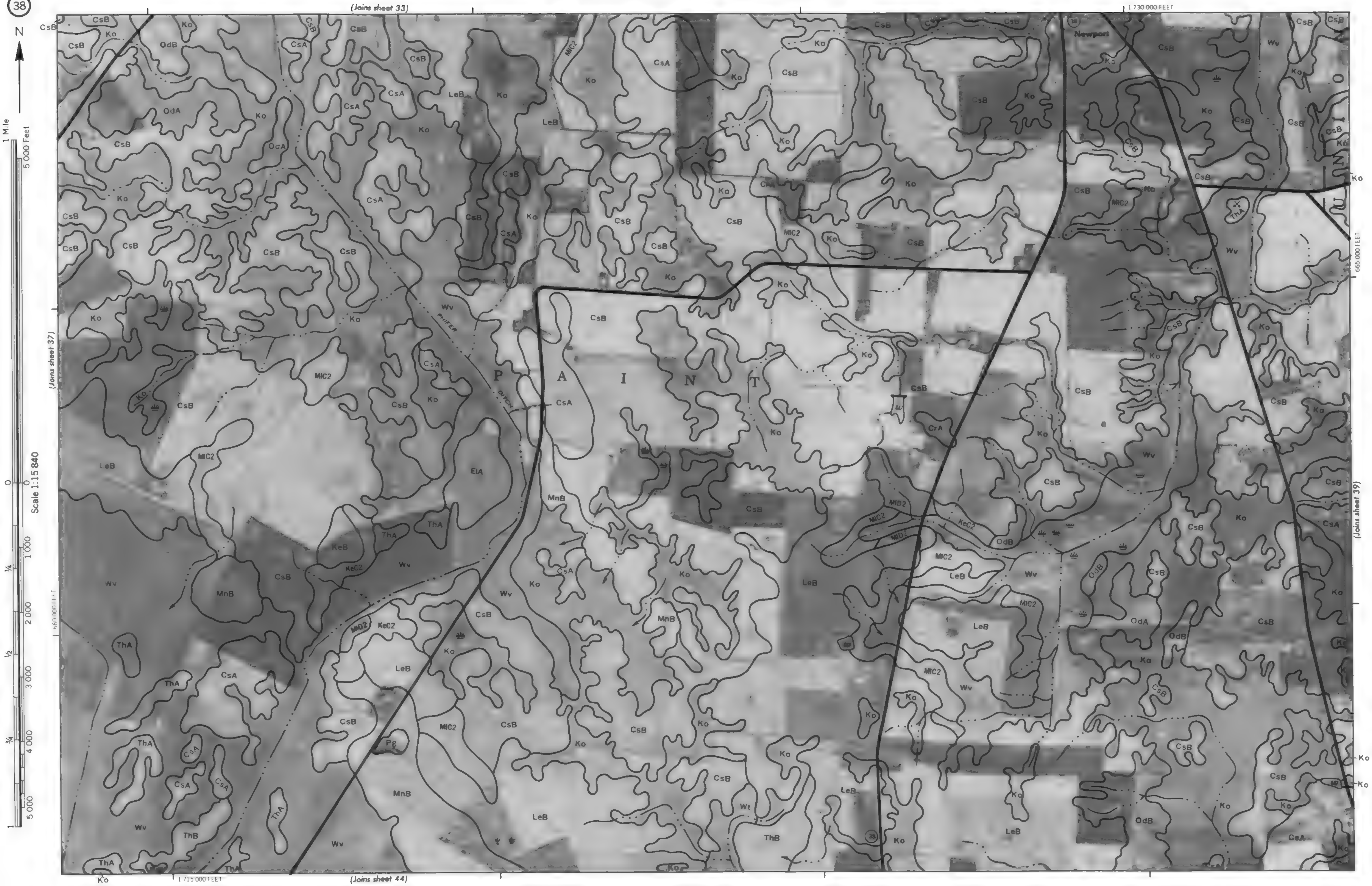

33
N
(Joins sheet 28)
(Joins sheet 32)
(Joins sheet 34)
(Joins sheet 38)
1 715 000 FEET
1 730 000 FEET
680 000 FEET
670 000 FEET
UNION
PAINT
Newport
Scale 1:15 840
1 Mile
5 000 Feet


(Joins sheet 29)
(Joins sheet 33)
(Joins sheet 35)
(Joins sheet 39)
N
1 Mile
5 000 Feet
Scale 1:15 840
1 735 000 FEET
680 000 FEET
670 000 FEET
U N I O N
O A K R U N
Walnut Run
Oak Run
water
56
CsA
CsB
Ko
LeB
ElB
ElA
ElC2
MlC2
MlD2
MlE2
MlB
Mk
So
Wt
OdA
OdB
MnB
CrA
Pg

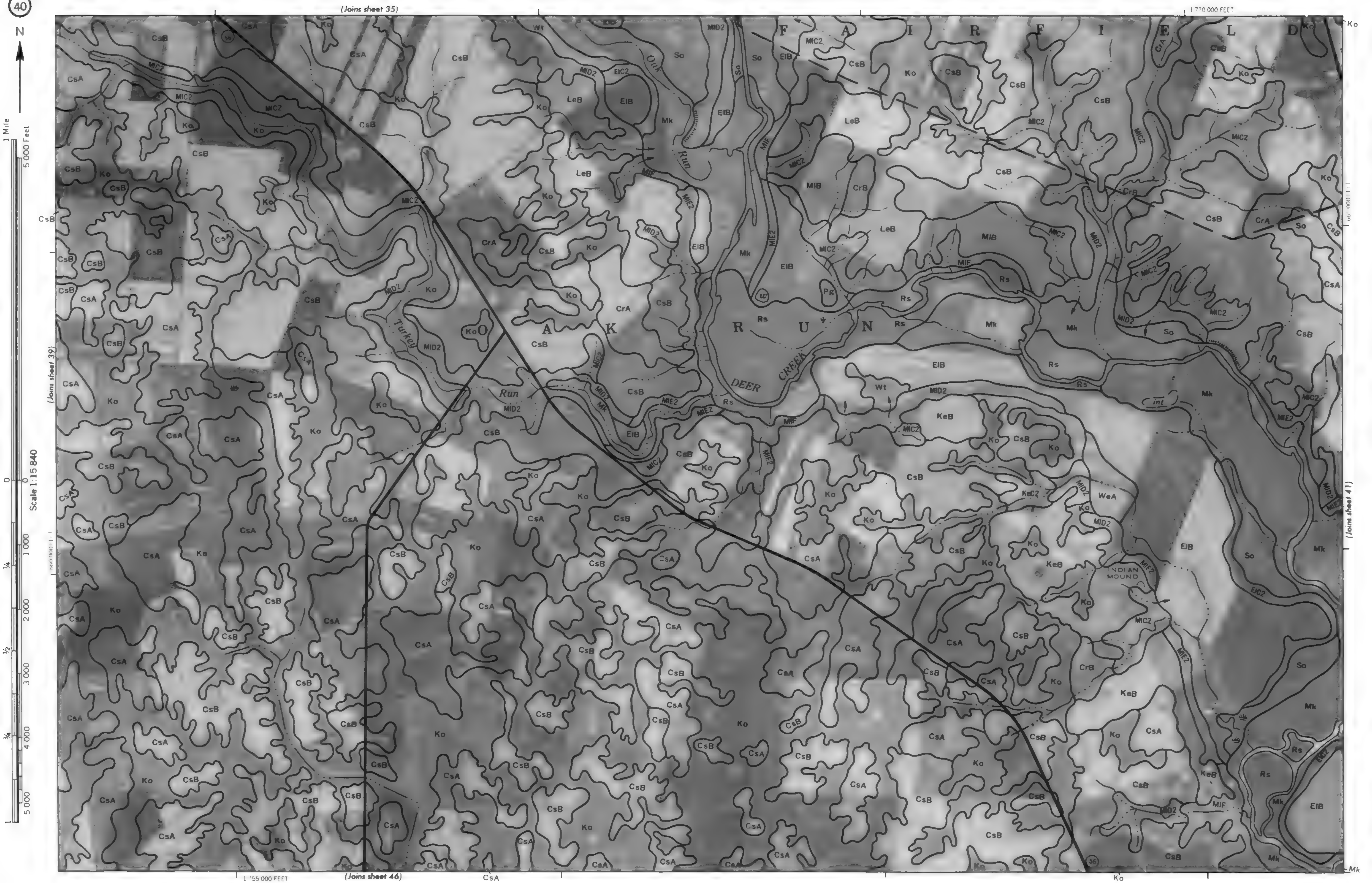

1 755 000 FEET
(Joins sheet 30)
680 000 FEET
MADISON LAKE
UNION
OAK RUN
FAIRFIELD
DEER CREEK
Glade Run
Wt Run
Oak Run
water
(Joins sheet 34)
(Joins sheet 36)
(Joins sheet 40)
670 000 FEET
1 770 000 FEET
N
1 Mile
5 000 Feet
Scale 1:15 840
0
1/4
1/2
3/4
1
1000
2000
3000
4000
5000
MIB
MIC2
MID2
MIE2
MIF
EIA
EIB
EIC2
So
CsA
CsB
LeB
Ko
Wt
KeB
MnB
MnC2
ThA
Pa
Pg
WeA
Mk


36
N
(Joins sheet 31)
(Joins sheet 35)
(Joins sheet 41)
1 790 000 FEET
680 000 FEET
670 000 FEET
1 775 000 FEET
Wrightsville
Opossum Run
Big Plain
F A I R F I E L D
FRANKLIN COUNTY
1 Mile
5 000 Feet
Scale 1:15 840


37
N
1 695 000 FEET
670 000 FEET
660 000 FEET
1 710 000 FEET
(Joins sheet 32)
(Joins sheet 38)
(Joins sheet 43)
CLARK COUNTY
P A I N T
Paint Creek
1 Mile
5 000 Feet
Scale 1:15 840

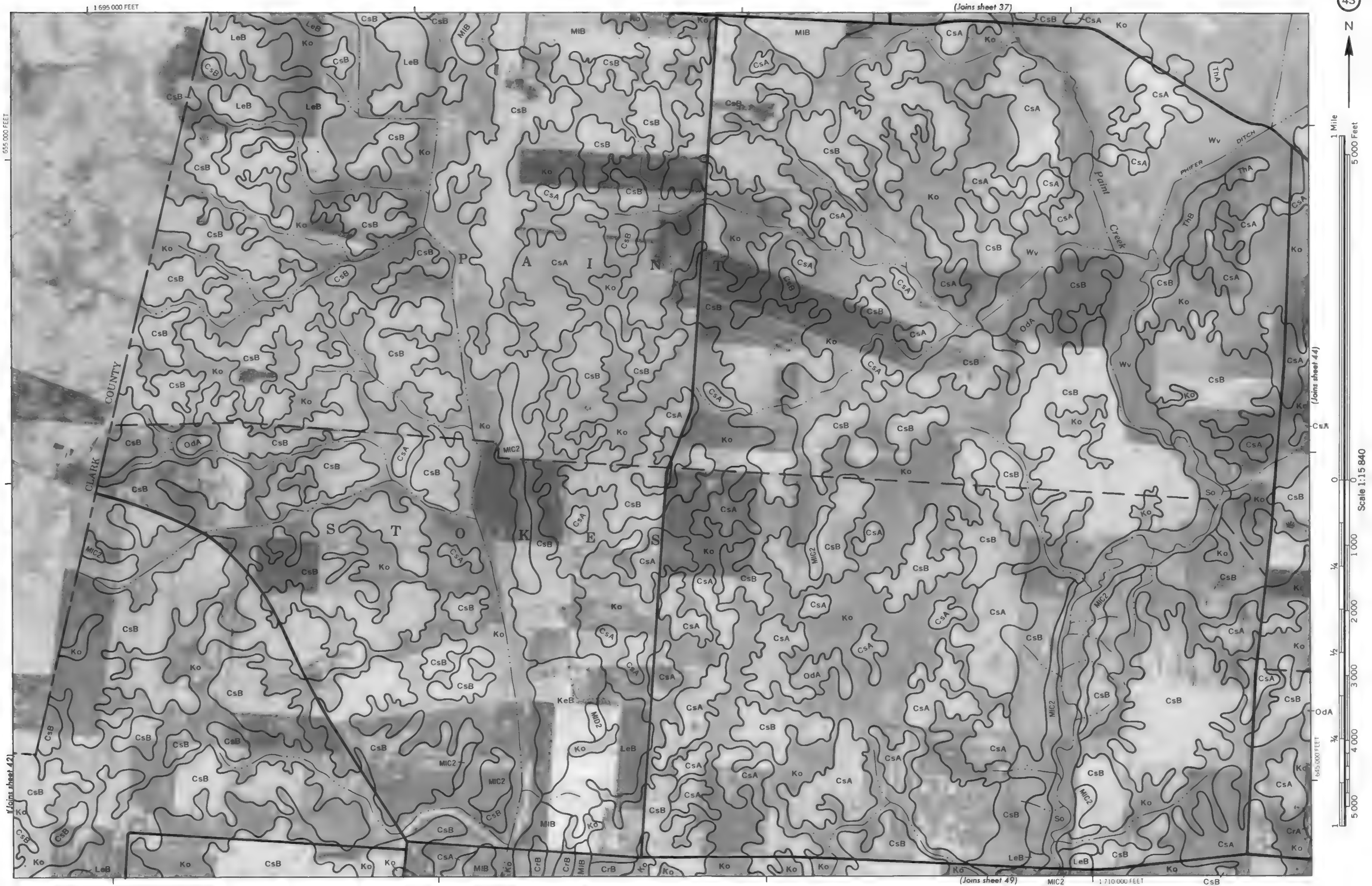

(Joins sheet 33)
(Joins sheet 37)
(Joins sheet 39)
(Joins sheet 44)
1 730 000 FEET
1 715 000 FEET
665 000 FEET
660 000 FEET
N
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
¼
2 000
½
3 000
¾
4 000
5 000
1
Newport
P A I N T
PHIFER DITCH
UNION
CsB
CsA
Ko
OdB
OdA
LeB
MlC2
MlD2
Wv
ThA
ThB
KeB
KeC2
MnB
ElA
CrA
Pg
Wt


39
N
(Joins sheet 34)
(Joins sheet 38)
(Joins sheet 40)
(Joins sheet 45)
1 735 000 FEET
1 750 000 FEET
665 000 FEET
660 000 FEET
U N I O N
P A I N T
O A K R U N
Bradford Creek
1 Mile
5 000 Feet
Scale 1:15 840


(Joins sheet 35)
(Joins sheet 39)
(Joins sheet 41)
(Joins sheet 46)
N
1 Mile
5 000 Feet
Scale 1:15 840
1 770 000 FEET
1 755 000 FEET
FAIRFIELD
OAK RUN
DEER CREEK
Turkey Run
Oak Run
INDIAN MOUND


(Joins sheet 36)
(Joins sheet 40)
(Joins sheet 47)
FAIRFIELD
DARBY
PLEASANT
FRANKLIN COUNTY
PICKAWAY COUNTY
DEER CREEK
Opossum Run
N
1 Mile
5 000 Feet
Scale 1:15 840
1 775 000 FEET
1 790 000 FEET
665 000 FEET
655 000 FEET


42
N
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
¼
2 000
½
3 000
¾
4 000
5 000
1
INSET A
1 795 000 FEET
710 000 FEET
707 000 FEET
1 793 000 FEET
Joins inset B
2000 AND 3000-FOOT GRID TICKS
BIG DARBY CREEK
FRANKLIN COUNTY
Darby Crest
JEFFERSON
INSET B
Joins inset A
1 795 000 FEET
705 000 FEET
701 000 FEET
1 793 000 FEET
2000 AND 4000-FOOT GRID TICKS
STOKES
CLARK COUNTY
GREENE COUNTY
(Joins sheet 48)
(Joins sheet 43)
1 675 000 FEET
1 690 000 FEET
CsA
CsB
Ko
LeB
Mk
MlE2
MlD2
MlF
MlC2
ElA
ElB
CrA
OdA



(Joins sheet 37)
(Joins sheet 44)
(Joins sheet 49)
(Joins sheet 42)
1 695 000 FEET
1 710 000 FEET
655 000 FEET
645 000 FEET
N
CLARK COUNTY
P A I N T
S T O K E S
Paint Creek
PHIFER DITCH
1 Mile
5 000 Feet
Scale 1:15 840
0
¼
½
¾
1
1 000
2 000
3 000
4 000
5 000

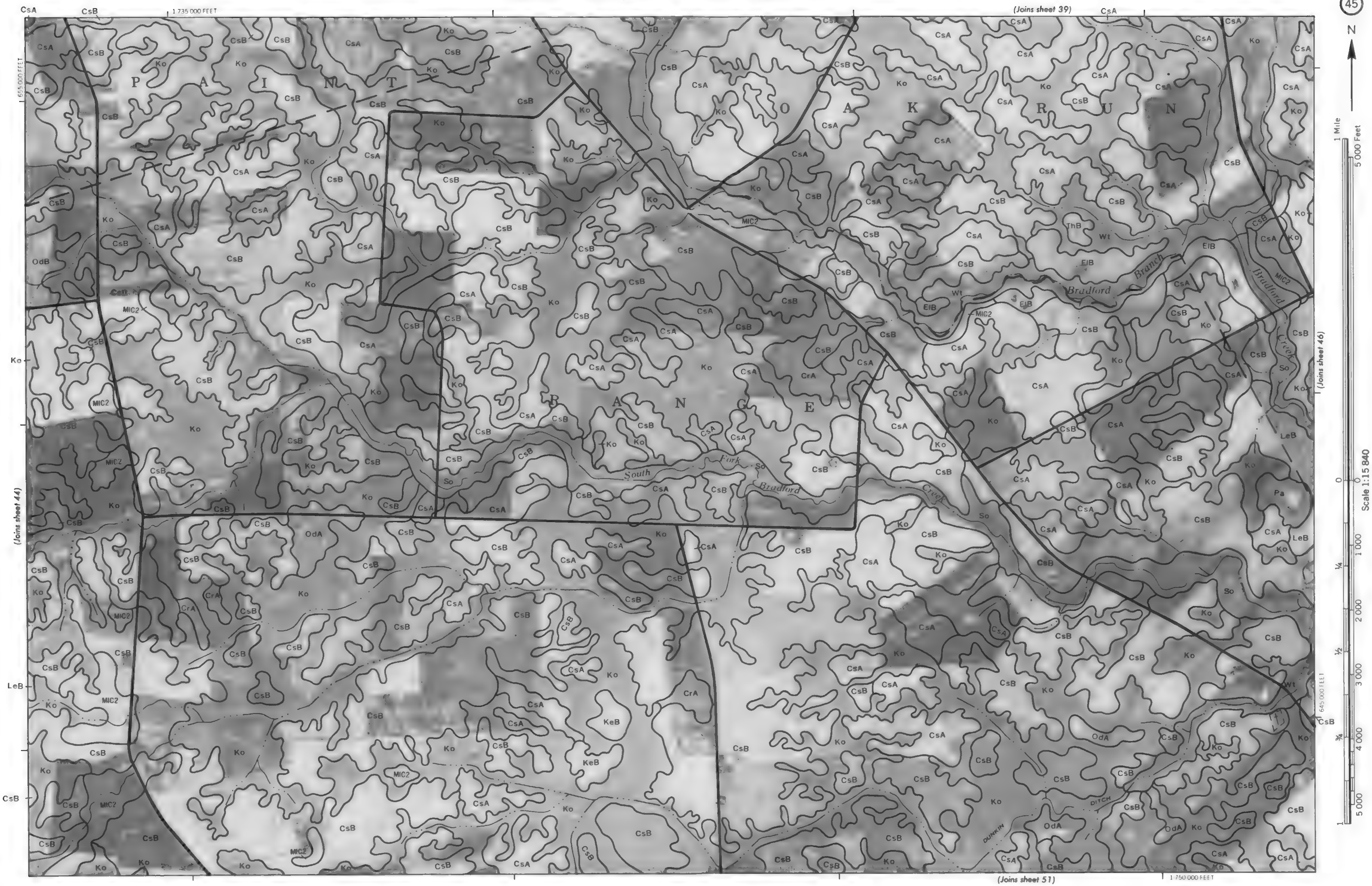
MADISON COUNTY, OHIO — SHEET NUMBER 44

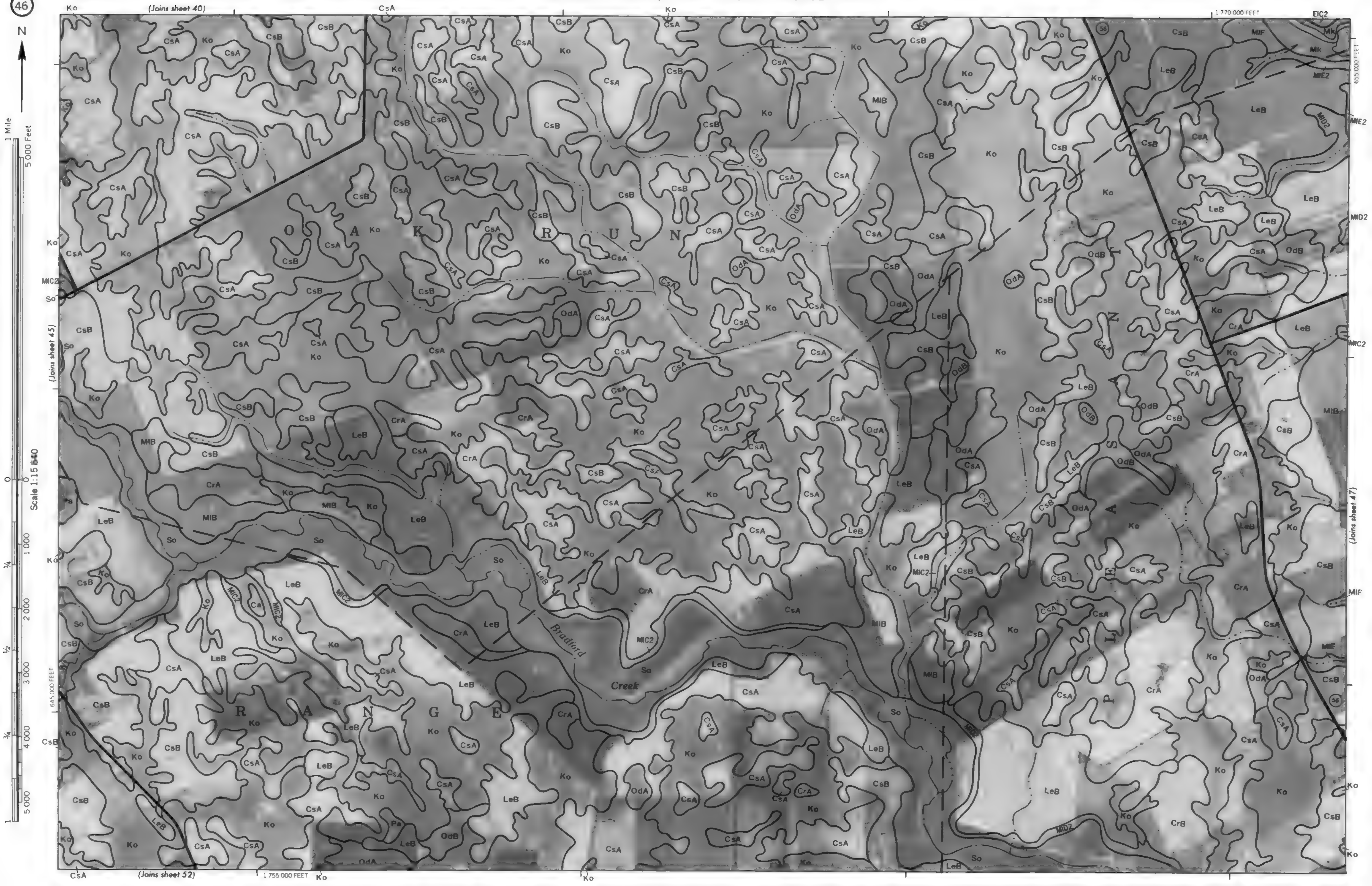
N

Scale 1:15 840

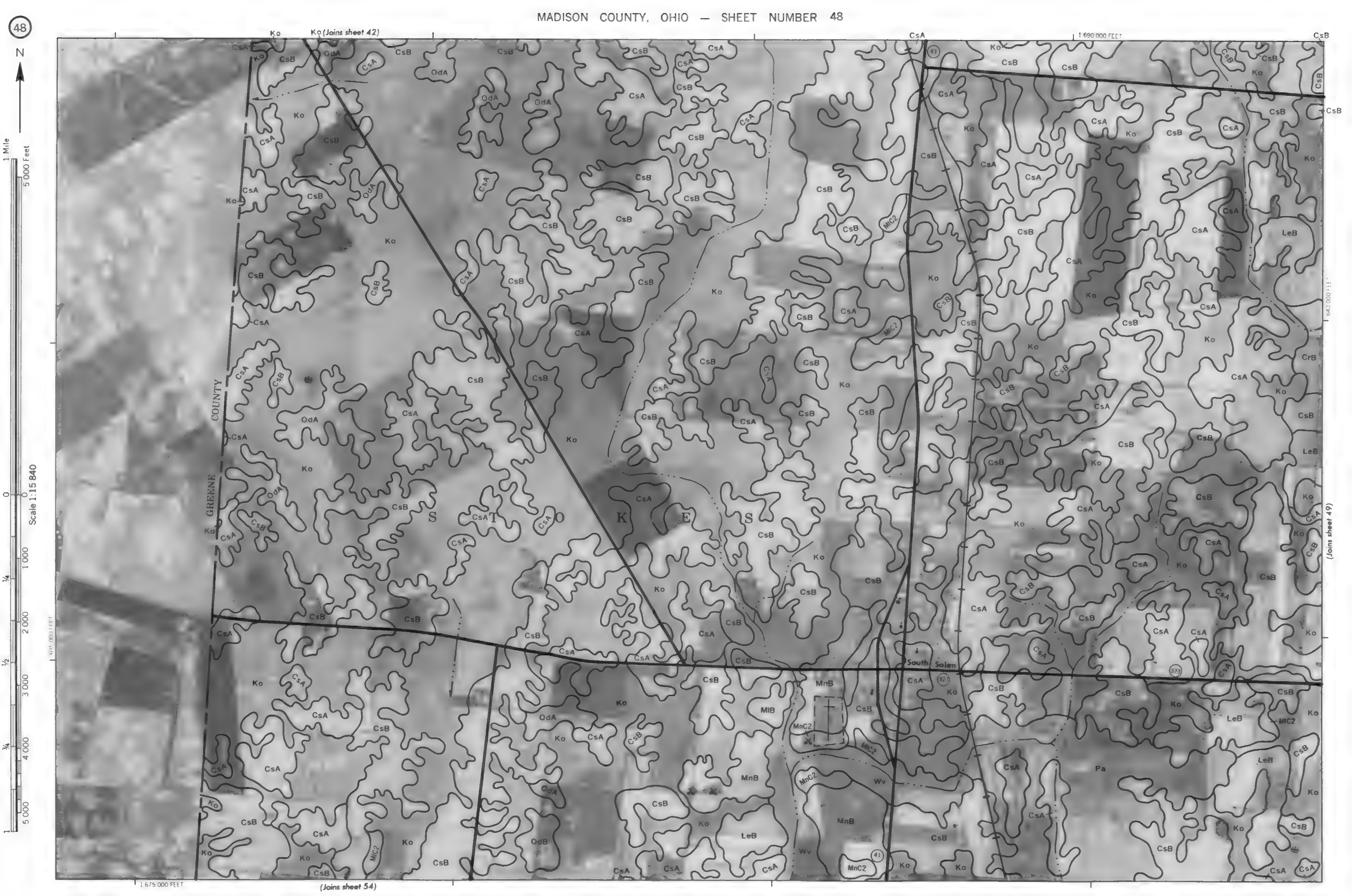
1 Mile ¾ ½ ¼ 0

5 000 Feet 4 000 3 000 2 000 1 000 0 5 000


45
N
(Joins sheet 39)
(Joins sheet 44)
(Joins sheet 46)
(Joins sheet 51)
1 735 000 FEET
1 750 000 FEET
655 000 FEET
645 000 FEET
P A I N T
O A K R U N
R A N G E
South Fork Bradford
Bradford Branch
Bradford Creek
DUNKIN DITCH
1 Mile
5 000 Feet
Scale 1:15 840
0 1/4 1/2 3/4 1
0 1 000 2 000 3 000 4 000 5 000
CsA
CsB
Ko
MlC2
OdA
OdB
CrA
KeB
LeB
EIB
ThB
Wt
So
Pa

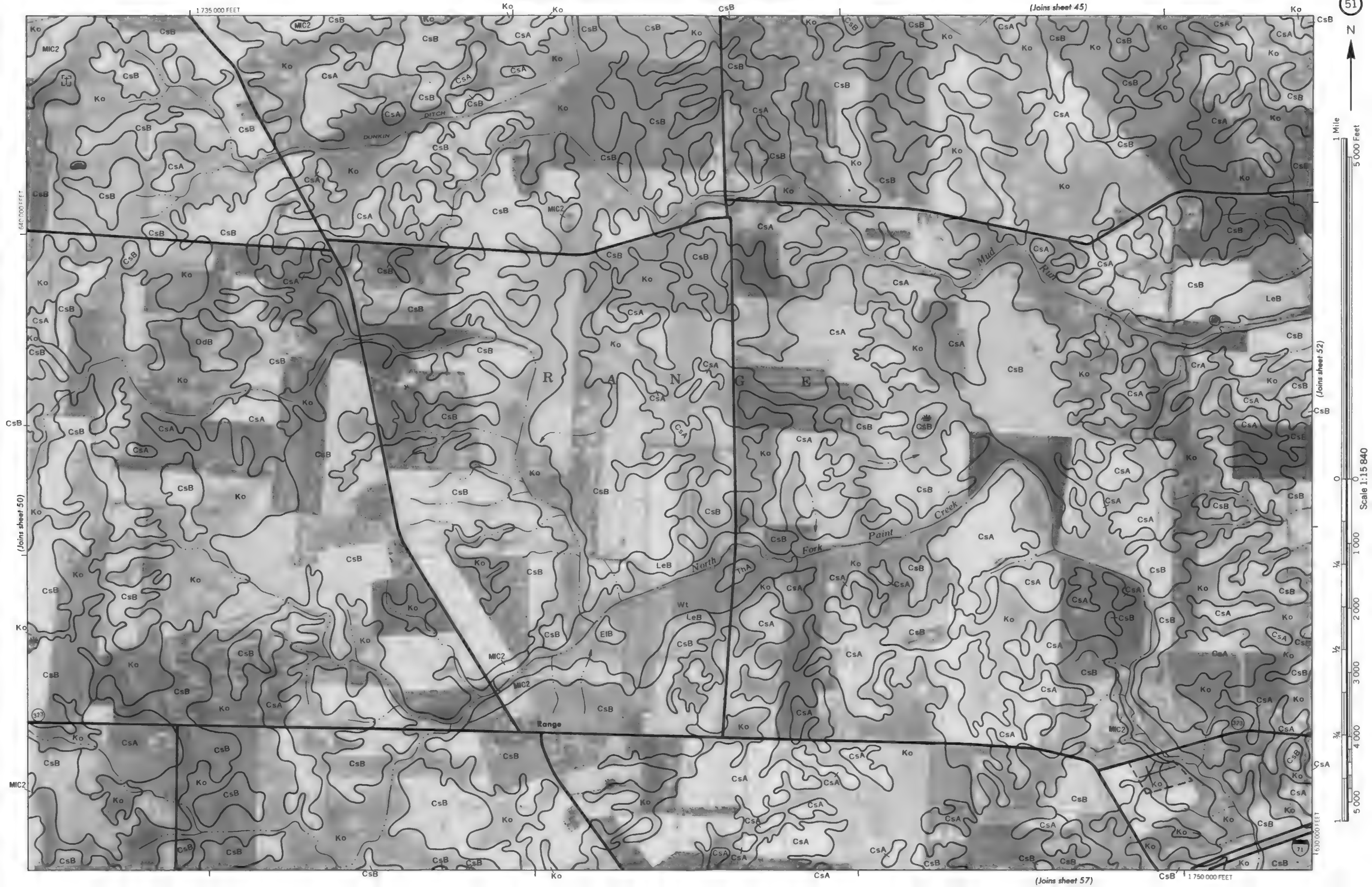

N
Scale 1:15 840
1 Mile
5 000 Feet
(Joins sheet 40)
(Joins sheet 45)
(Joins sheet 47)
(Joins sheet 52)
1 770 000 FEET
1 755 000 FEET
655 000 FEET
645 000 FEET
O A K R U N
R A N G E
P L E A S A N T
Bradford
Creek

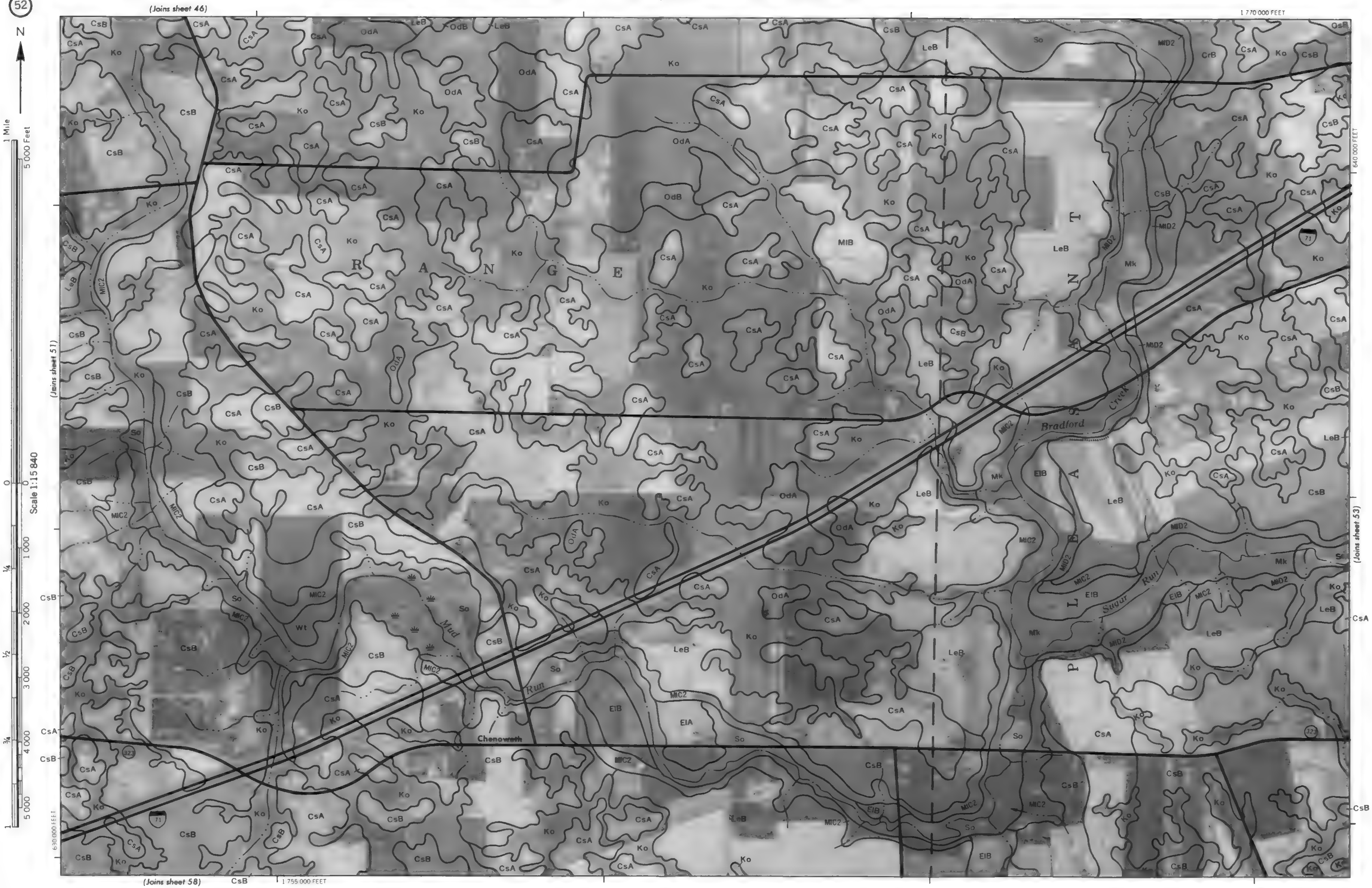

1 775 000 FEET
(Joins sheet 41)
47
N
655 000 FEET
(Joins sheet 46)
DEER CREEK
P L E A S A N T
McKendree
Antioch
PICKAWAY COUNTY
71
56
645 000 FEET
(Joins sheet 53)
1 790 000 FEET
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
2 000
3 000
4 000
5 000
¼
½
¾
1

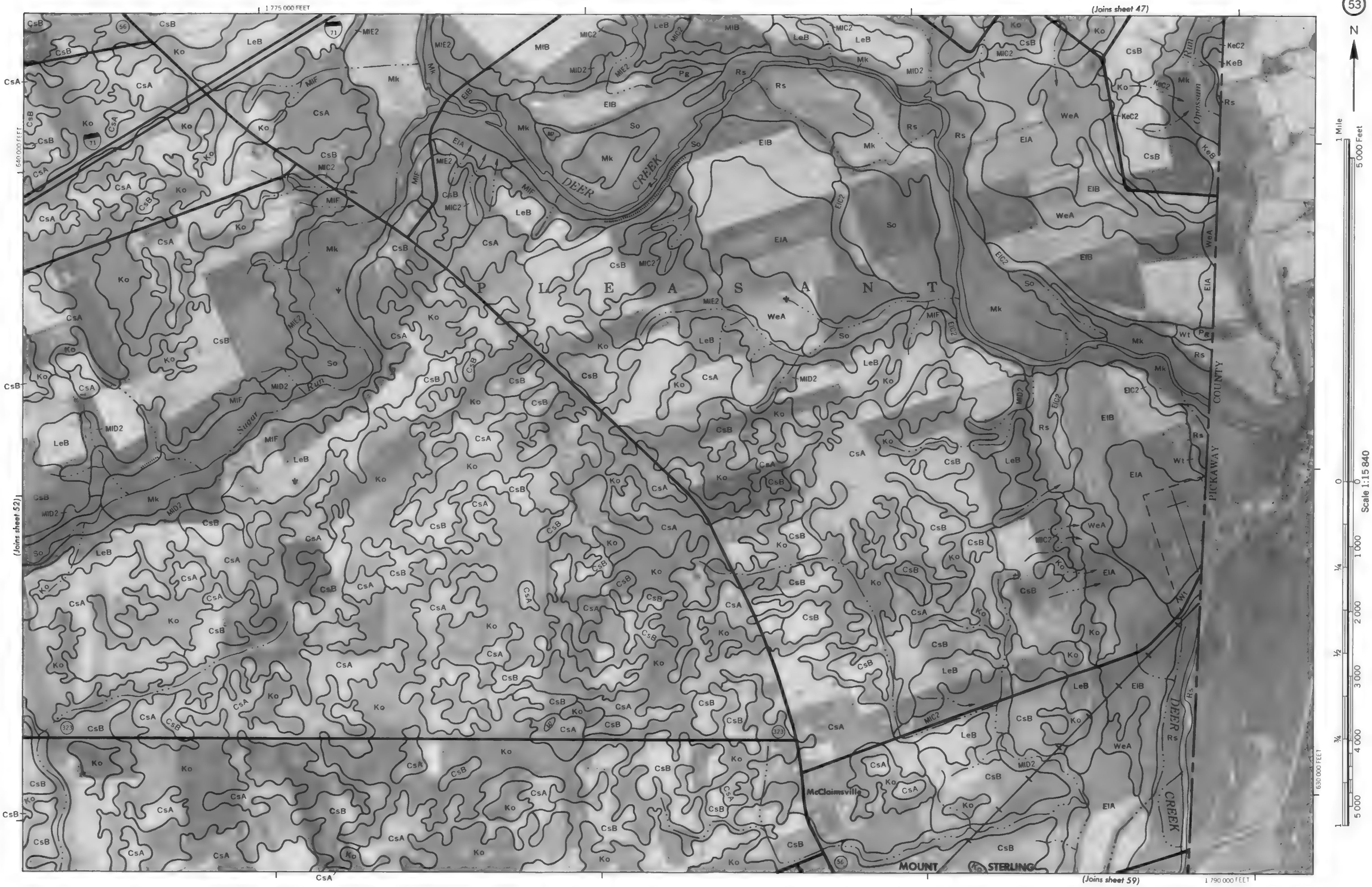

48
N
1 Mile
5 000 Feet
Scale 1:15 840
Ko (Joins sheet 42)
(Joins sheet 49)
(Joins sheet 54)
GREENE COUNTY
S T O K E S
South Solon
1 675 000 FEET
1 690 000 FEET
640 000 FEET
CsA
CsB
Ko
OdA
OdB
MlC2
MlB
MnB
MnC2
LeB
Wv
Pa
CrB


49
(Joins sheet 43)
(Joins sheet 50)
(Joins sheet 48)
(Joins sheet 55)
1 710 000 FEET
1 695 000 FEET
635 000 FEET
N
1 Mile
5 000 Feet
Scale 1:15 840
S T O K E S
Sugar Creek
Paint Creek

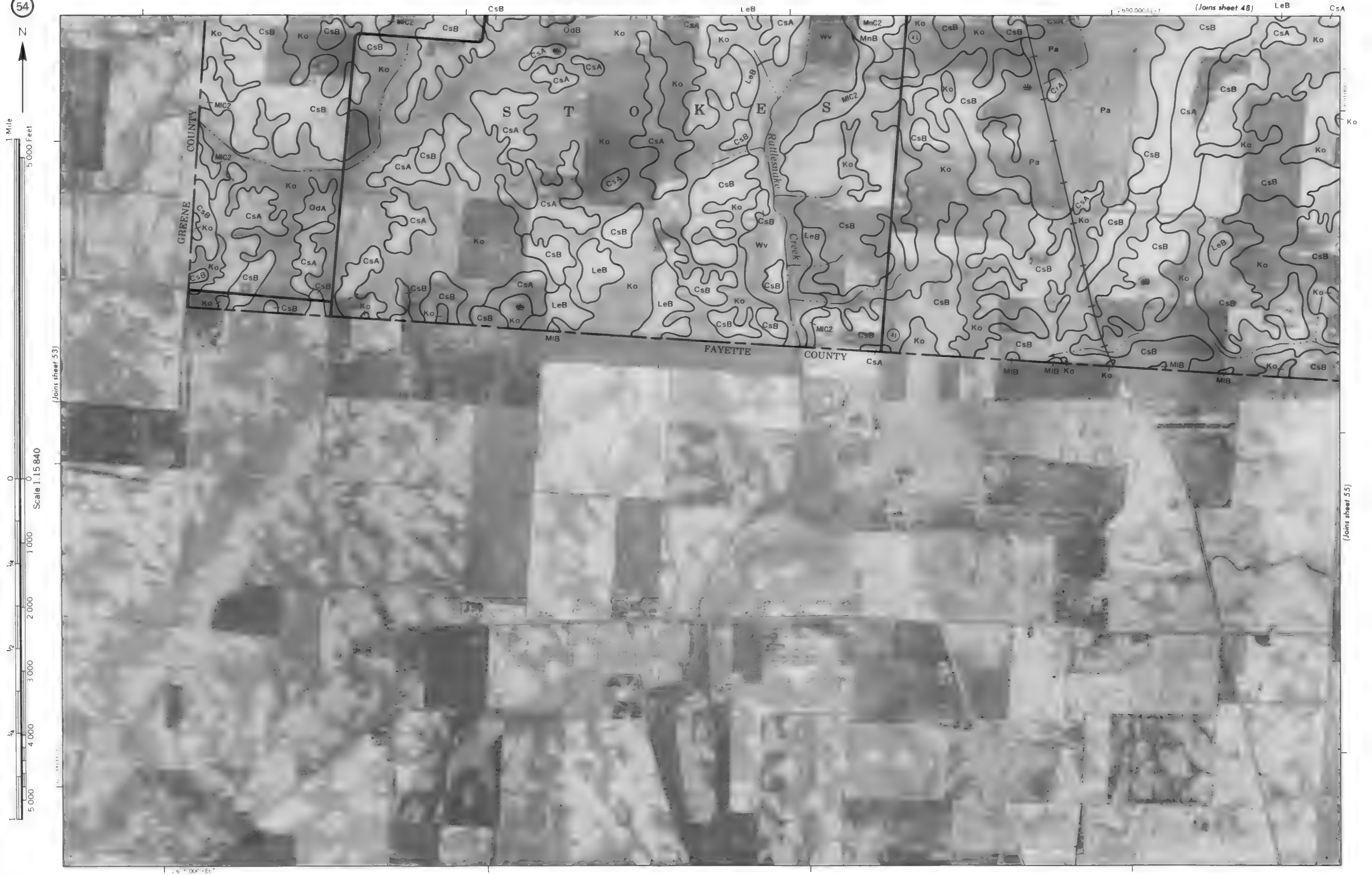

50
N
1 Mile
5 000 Feet
Scale 1:15 840
0
1000
2000
3000
4000
5000
¼
½
¾
1
(Joins sheet 44)
1 730 000 FEET
(Joins sheet 49)
(Joins sheet 51)
(Joins sheet 56)
1 715 000 FEET
640 000 FEET
635 000 FEET
S T O K E S
R A N G E
WILLIAM CATHCART DITCH
Midway
38
323
Ko
CsA
CsB
CrA
OdA
OdB
MlB
ElB
LeB
MlC2
MnB
MnC2
MlD2
Wt
Wv
ThA


(Joins sheet 45)
(Joins sheet 50)
(Joins sheet 52)
(Joins sheet 57)
1 735 000 FEET
1 750 000 FEET
640 000 FEET
630 000 FEET
N
Scale 1:15 840
1 Mile
5 000 Feet
Dunkin Ditch
Mud Run
North Fork Paint Creek
R A N G E
Range
CsA
CsB
Ko
MlC2
OdB
LeB
CrA
ThA
Wt
ElB


52
N
(Joins sheet 46)
(Joins sheet 51)
(Joins sheet 53)
(Joins sheet 58)
1 770 000 FEET
1 755 000 FEET
640 000 FEET
630 000 FEET
R A N G E
P L A T T E
Bradford Creek
Sugar Run
Mud Run
Chenoweth
71
323
1 Mile
5 000 Feet
Scale 1:15 840
0
¼
½
¾
1
1 000
2 000
3 000
4 000
5 000


53
(Joins sheet 47)
(Joins sheet 52)
(Joins sheet 59)
1 775 000 FEET
640 000 FEET
630 000 FEET
1 790 000 FEET
N
1 Mile
5 000 Feet
Scale 1:15 840
P L E A S A N T
DEER CREEK
Sugar Run
Opossum Run
PICKAWAY COUNTY
McClaimsville
MOUNT STERLING

MADISON COUNTY, OHIO — SHEET NUMBER 54




1 695 000 FEET
(Joins sheet 49)
630 000 FEET
S T O K E S
Sugar Creek
Paint Creek
FAYETTE COUNTY
(Joins sheet 54)
(Joins sheet 56)
620 000 FEET
1 710 000 FEET
N
1 Mile
5 000 Feet
Scale 1:15 840
0
1/4
1/2
3/4
1
1 000
2 000
3 000
4 000
5 000
729
CsA
CsB
Ko
KeB
LeB
Pg
Pa
Wt
OdA
MlB
MlC2
MlD2
MlE2
ElA
ElB
ElC2
Mk
So


56
N
(Joins sheet 50)
(Joins sheet 55)
(Joins sheet 57)
1 730 000 FEET
630 000 FEET
620 000 FEET
1 715 000 FEET
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
¼
2 000
½
3 000
¾
4 000
5 000
1
R A N G E
FAYETTE COUNTY
WILLIAM CATHCART DITCH
East Fork Paint Creek
38
CsA
CsB
Ko
Wt
Wv
ThA
ThB
MlD2
MlC2
MlB
MnC2
MnB
LeB
ElA
ElB
CrA
Pg


57
N
1 735 000 FEET
630 000 FEET
620 000 FEET
1 750 000 FEET
(Joins sheet 51)
(Joins sheet 56)
(Joins sheet 58)
R A N G E
Thompson Creek
North Fork Paint Creek
FAYETTE COUNTY
71
Ko
CsA
CsB
CrA
LeB
MIC2
1 Mile
5 000 Feet
0
¼
½
¾
1
1 000
2 000
3 000
4 000
5 000
Scale 1:15 840


N
(Joins sheet 52)
(Joins sheet 57)
(Joins sheet 59)
1 770 000 FEET
1 755 000 FEET
625 000 FEET
620 000 FEET
Scale 1:15 840
1 Mile
5 000 Feet
RANGE
PLEASANT
North Fork Paint Creek
FAYETTE COUNTY
CsA
CsB
Ko
OdA
LeB
ElB
Pa
So
MnC2
MlC2
MlD2
MnB
Wt
CrA


59
N
1 775 000 FEET
(Joins sheet 53)
(Joins sheet 58)
625 000 FEET
620 000 FEET
1 790 000 FEET
MOUNT STERLING
Burr Oaks Heights
P L E A S A N T
DEER CREEK
FAYETTE COUNTY
PICKAWAY COUNTY
CsA
CsB
Ko
MlB
MlC2
MlD2
MlE2
MlF
ElA
ElB
KeB
OdA
OdB
Rs
Mk
So
WeA
Wt
1 Mile
5 000 Feet
0
¼
½
¾
1
1 000
2 000
3 000
4 000
5 000
Scale 1:15 840